SYSTEMATICS OF THE PAINTED SPINY POCKET MOUSE *LIOMYS PICTUS* (RODENTIA: HETEROMYIDAE) FROM COLIMA AND SOUTHERN JALISCO, MEXICO.

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SYSTEMATICS OF THE PAINTED SPINY POCKET MOUSE

LIOMYS PICTUS (RODENTIA: HETEROMYIDAE)

FROM COLIMA AND SOUTHERN JALISCO, MEXICO.

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DEDICATION

I dedicate this thesis to my parents Alfonso and Hortensia Correa, to my sister Gabriela Morales de Sanchez, and to my friend Roy Lee Lopez. To all of them my sincerest appreciation for their support and encouragement.

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INTRODUCTION

Spiny pocket mice of the genus Liomys (Rodentia: Heteromyidae) comprise five species: L. irroratus, L. pictus, L. spectabilis, L. salvini, and L. adspersus. The geographic range of the genus extends from northern Sonora in western Mexico and southern Texas, southward to the vicinity of the Panama Canal Zone (Genoways,1973).

Liomys pictus occurs mostly in the coastal lowlands and contiguous slopes of the Sierra Madre Occidental and Sierra Madre del Sur in western Mexico. The species also occurs at some localitites in the Central Valley of Chiapas, the Isthmus of Tehuantepec, and eastern coastal regions north to central Veracruz (Genoways,1973; McGhee and Genoways, 1978).

In his review of Liomys, Genoways (1973) recognized four subspecies of L. pictus (Fig. 1): L. p. annectens (confined to high elevations in the Sierra Madre del Sur of Guerrero and Oaxaca); L. p. hispidus (ranging from northern Sonora southward to the vicinity of San Blas,

Nayarit); L. p. pictus (occurring in western Mexico from Santiago, Nayarit southward to Chiapas and Guatemala, the Isthmus of Tehuantepec, and Veracruz); and L. p. plantinarensis (confined to the basins of internal drainage of southeastern Jalisco and western Michoacan and in the drainages of the Rio Coahuayana in southern Jalisco and eastern Colima, Rio Tepalcatepec in Michoacan, Rio Balsas in Guerrero, and their tributaries). Distinction among these subspecies was based largely on external and cranial size differences, and on pelage coloration.

Liomys pictus was first described by Thomas (1893) with specimens from Mineral San Sebastian, Jalisco. Merriam (1902) described L. plantinarensis from Platanar, Jalisco, separating it as a different species from L. pictus by its much smaller size, notched nasals, narrower interparietal, and smaller and more decurved rostrum and nasals. Goldman (1904) later regarded L. plantinarensis as a subspecies of L. pictus.

In his systematic account of the subspecies of L. pictus, Genoways (1973) mentioned a problem concerning subspecific allocation of some populations of spiny pocket mice from Colima and southern Jalisco where L. p. pictus and L. p. plantinarensis contact. He found that in

contact, the two otherwise distinct taxa intergraded (presumably as the result of hybridization) over a fairly narrow zone. Whereas some individuals from localities a few kilometers apart were easily referred to one or the other subspecies, other individuals appeared to be intergrades. Genoways could not fully resolve the nature and extent of this contact zone because of the small number of specimens available to him.

Beck and Kennedy (1977) analyzed standard karyotypes of individuals of Liomys pictus from three localities in the state of Colima. These included 10 specimens from Playa de Oro (altitude sea level), 11 from El Cobano (altitude approximately 3000 ft.), and seven from 2.5 mi. SE San Antonio (altitude approximately 5000 ft.). They found no interlocality or intralocality polymorphism for any of these three populations. However, they suggested that some polymorphism might exist for the Y-chromosome, because their specimens had a medium sized submetacentric Y, whereas Genoways (1973) referred to this chromosome as a medium sized metacentric. The specimens used by Genoways for his karyotypic descriptions of this species were: one from 4 km NE Contla, Jalisco, one from 2 km NW Emiliano Zapata, Jalisco, and one from Rio Cuchajaqui, 8 mi. S Alamos, Sonora. The diploid number of Liomys pictus

is 48, and the fundamental number is 66 (Beck and Kennedy, 1977; Genoways, 1973).

During the summer of 1985, I collected Liomys pictus from southern Jalisco and Colima. Analysis of these collections suggested that the ranges of L. p. pictus and L. p. plantinarensis overlap geographically with apparently a small amount of introgression occurring. The purpose of this paper is to analyze patterns of morphological variation among populations of Liomys pictus from southern Jalisco and Colima, and to assess the extent of morphological differentiation between the subspecies L. p. pictus and L. p. plantinarensis in this area of Mexico.

MATERIALS AND METHODS

A total of 1482 specimens of Liomys pictus was examined from 165 different geographic localities. Specimens examined are listed in Appendix 1 and institutions housing those specimens are as follows (abbreviations after Choate and Genoways, 1975): American Museum of Natural History (AMNH); Angelo State Natural History Collections, Angelo State University (ASNHC); California Academy of Sciences (CAS); Department of Biological Sciences, University of Arizona (UA); Field Museum of Natural History (FMNH); Instituto de Biologia, Universidad Nacional Autonoma de Mexico (UNAM); Los Angeles County Museum (LACM); Michigan State University (MSU); Museum of Natural History, University of Illinois (UIMNH); Museum of Natural History, University of Kansas (KU); Museum of Vertebrate Zoology, University of California, Berkeley (MVZ); Museum of Zoology, Louisiana State University (LSUMZ); Museum of Zoology, Memphis State University (MSUMZ); Museum of Zoology, University of Michigan (UMMZ); National Museum of Natural History (USNM); Stovall Museum of Science and History, University

of Oklahoma (OU); Texas Cooperative Wildlife Collections, Texas A&M University (TCWC).

Each specimen was assigned to one of six age classes as defined by Rogers and Schmidly, 1982. Four external and 14 cranial measurments, and three qualitatively assessed cranial and pelage characters were recorded for each specimen. These included: total length (TL), length of tail (LT), length of hind foot (LHF), and length of ear (LE) recorded from museum tags. Cranial measurments were taken with dial calipers to the nearest 0.05 mm and included: greatest length of skull (GLS), zygomatic breadth (ZB), postorbital constriction (POC), mastoid breadth (MB), length of nasals (LN), length of premaxillary bones (LPM: measured from the anteriormost projection of the nasal bones to the posteriormost projection of the premaxillaries), length of rostrum (LR), interparietal width (IW), interparietal length (IL), length of maxillary toothrow (LMT), total length of toothrow (TLT), breadth across molars (BM), postdental palatal width (PPW), and depth of braincase (DBC). Qualitatively assessed characters included: posterior margin of interparietal (PMI: notched, slightly notched, or unnotched), condition of interparietal (COI: divided or undivided), and brigthness of lateral line (LL: faint, medium, or brightly colored). Measurments were taken as

described by Genoways (1973) and Rogers and Schmidly (1982), except where indicated. All statistical analyses were performed using procedures of the Statistical Analysis System (SAS, SAS Institute Inc., 1982).

Nongeographic variation was analyzed in a sample of 118 individuals from localities near Chamela, Jalisco, as follows: 0.5 mi S Chamela (2), 3 mi E Chamela (9), 4 mi N Chamela (8), 6 km E Chamela (8), 6 mi S, 0.5 mi E Chamela (3), 8 km E Chamela (47), Bay of Chamela (6), and Cuitzmala (13). These localities are no more than 30 km apart in homogeneous coastal Tropical Subdeciduous Forest. Therefore, for purposes of the nongeographic analysis, these specimens were considered to represent a single population.

On the nongeographic sample, procedure MEANS was used to obtain standard statistics (mean, range, standard deviation, standard error, variance, and coefficient of variation) for each sex in each age class. Procedure TTEST was used to perform a Student's t-test (or an approximation if variances were unequal) to test for significant differences due to sexual dimorphism in each of the six age classes. Procedure GLM was used to perform a model I, single-classification analysis of variance (ANOVA) to test for significant differences among age

classes, and a Tukey-Kramer's multiple range test was used to determine maximally nonsignificant subsets. A model I, two-way multivariate analysis of variance (MANOVA) was performed to test for the overall significance of sex and age across all characters. With the procedure VARCOMP, variance partitioning of a model II, two-way ANOVA was used to estimate the percentage contributions of sex, age, sex by age interaction, and error to within sample variation. Sex and age were considered random factors (Leamy, 1983). Because the data were unbalanced and consequently, the main effects (sex and age) were not independent, these tests were run once with sex entered first and once with age entered first (Straney, 1978).

For analysis of geographic variation, specimens were assigned to one of 58 geographic samples or grouped localities (Fig. 1). Localities were grouped so as to maximize sample size without crossing major physiographic or previously recognized taxonomic boundaries. These group localities were constituted as follows: Sample 1 -- Jalisco: 24 mi NW Chamela; 12 mi NW Chamela. Sample 2 -- Jalisco: 0.5 mi S Chamela; 3 mi E Chamela; 4 mi N Chamela; 6 km E Chamela; 6 mi S, 0.5 mi E Chamela; 8 km E Chamela; Bay of Chamela; Estacion de Biologia UNAM; Cuitzmala. Sample 3 -- Jalisco: 11 mi SW Autlan; 2 mi SW La Resolana; 20 km WNW Purificacion; 5 mi SW Tecomate; 7.5 mi SE

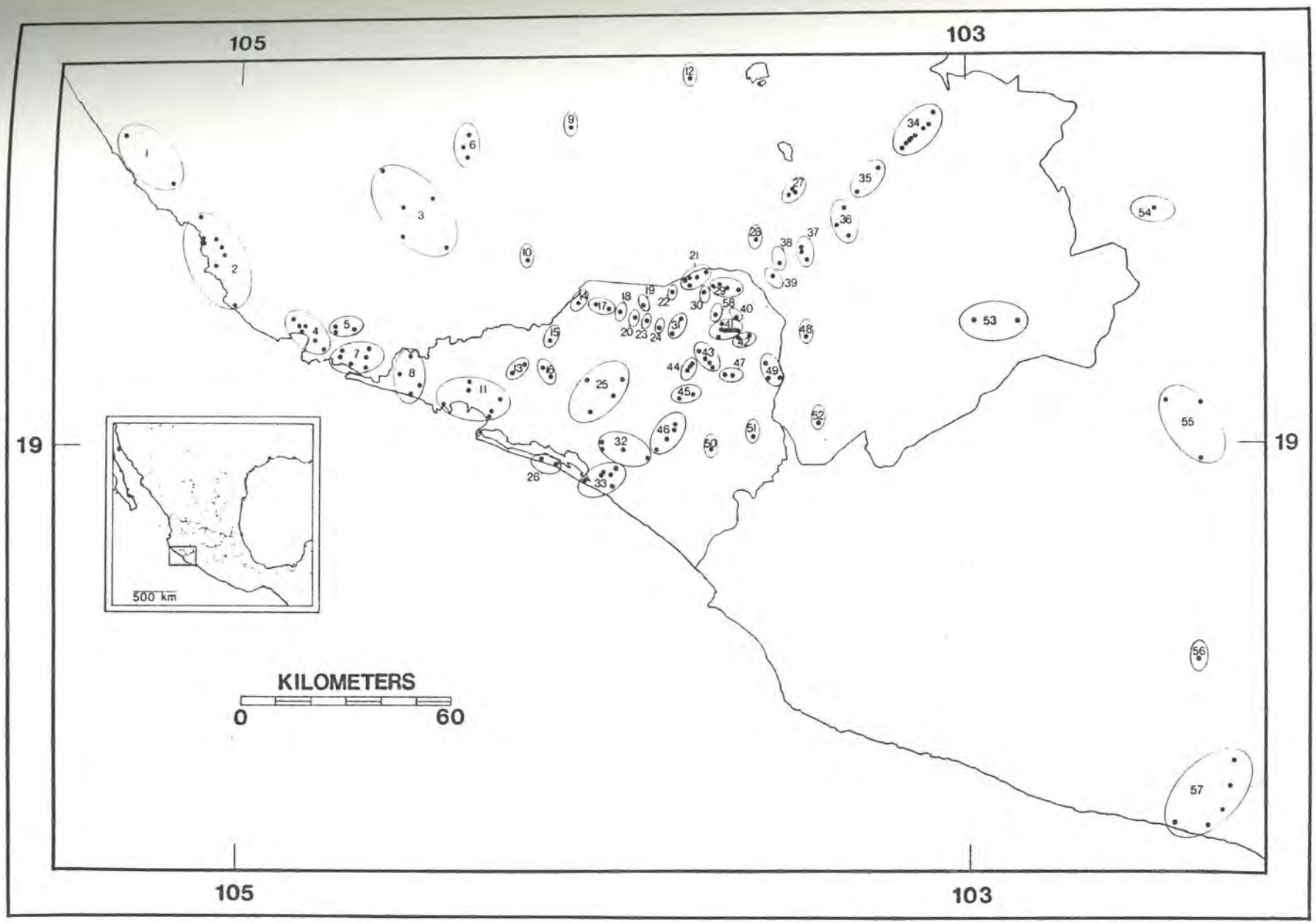
Tecomate. Sample 4 -- Jalisco: 10 mi nw San Patricio; 2 mi N Tenacatita; 9.5 mi NW Melaque; Bay of Tenacatita; 10 mi NW Barra de Navidad; 8 mi NW Barra de Navidad; 2 km NW Emiliano Zapata. Sample 5 -- Jalisco: 6.5 mi N Melaque; 5.5 mi N Melaque; 15 km nw Cihuatlan. Sample 6 -- Jalisco: 2 mi SSE Autlan; 2.5 mi NNE Autlan; La Cumbre de Autlan. Sample 7 -- Jalisco: 3 mi E Barra de Navidad; 3 mi nw Barra de Navidad; 5 km NNW Barra de Navidad; 5 mi NE Barra de Navidad; 0.5 mi N Barra de Navidad; Barra de Navidad; 5 mi W Cihuatlan. Sample 8 -- Jalisco: Cihuatlan; Colima: El Charco; 2 mi SE Cihuatlan; 18 km W Santiago; Playa de Oro. Sample 9 -- Jalisco: 6 mi E El Limon. Sample 10 -- Jalisco: 14 km S Durazno. Sample 11 -- Colima: 3 km S Santiago; 3 mi N Santiago; 4 mi W, 1 mi S Santiago; 6 km N Santiago; 5 mi N Manzanillo; 2 km N Tlapeixtes; 2 km N Manzanillo. Sample 12 -- Jalisco: 7 mi SE Tapalpa. Sample 13 -- Colima: 1 km N Comatlan; 18 km NNE Manzanillo. Sample 14 -- Colima: Minatitlan. Sample 15 -- Colima: 30 km NNE Manzanillo. Sample 16 -- Colima: 2 mi NE Camotlan. Sample 17 -- Colima: 31 km NW Colima; 34 km NW Colima. Sample 18 -- Colima: 29.5 km NW Colima. Sample 19 -- Colima: 11 mi W Comala. Sample 20 -- Colima: 22 km NW Colima. Sample 21 -- Colima: 1 km NE San Antonio; 2 km NE San Antonio; 2.5 mi SE San Antonio; San Antonio; 5 mi NE La Cofradia; 7 mi NE La Cofradia. Sample 22 -- Colima: La Cofradia. Sample 23 -- Colima: 17 km NW Colima. Sample 24 -

- Colima: 13 km NW Colima. Sample 25 -- Colima: Cerro Chino; 29 km W Pueblo Juarez; 5 km SE Pueblo Juarez; Pueblo Juarez. Sample 26 -- Colima: 5.6 mi NW Cuyutlan; 8.4 mi NW Cuyutlan. Sample 27 -- Jalisco: 5 mi S Cd. Guzman; 2.7 mi WNW Zapoltitic; 3.5 mi WNW Zapoltitic. Sample 28 -- Jalisco: 9.8 mi W Atenquique. Sample 29 -- Colima: 13 km NE Comala; 5.5 km W Queseria; 6.9 mi W Queseria; 8.5 km W Queseria. Sample 30 -- Colima: 14.5 mi N Colima. Sample 31 -- Colima: 8 km NW Colima; Comala. Sample 32 -- Colima: 5 mi NNE Armeria; 8 km NNE Tecoman; 2.4 km S Rincon de Lopez; 4.7 km S Rincon de Lopez. Sample 33 -- Colima: 4 km SW Armeria; 3 km S Armeria; Armeria; Paso del Rio; 6 km NE Cuyutlan; 7 km NE Cuyutlan; 3 mi E Cuyutlan; Cuyutlan. Sample 34 -- Jalisco: 9 mi NE Contla; 11 km NE Contla; 10 km NE Contla; 2.2 mi NE Contla; 3 mi NE Contla; 4 km NE Contla; 1.8 mi NE Contla; 1.3 mi NE Contla. Sample 35 -- Jalisco: 1 km SW San Mames; 4 km NE Tamazula. Sample 36 -- Jalisco: 13 km SW Tamazula; 4 km W Tuxpan; 8 km N Tecalitlan. Sample 37 -- Jalisco: 6 km S Atenquique; 1 km N Platanar; Arroyo de Platanar. Sample 38 -- Jalisco: 2 km NE San Marcos. Sample 39 -- Jalisco: 5 km SW San Marcos. Sample 40 -- Colima: 9 mi NNE Colima. Sample 41 -- Colima: 4 mi NNE Colima; El Cobano; 0.25 mi E El Cobano; 0.5 mi E El Cobano; 0.5 mi W El Cobano; 0.7 mi NE El Cobano; 0.8 mi E El Cobano; 1 mi ESE El Cobano; 1 mi W El Cobano; 1.4 mi E El Cobano; 2 mi NW El Cobano. Sample

42 -- Colima: 10 km NW Alzada; 6 km S Cuauhtemoc. Sample 43 -- Colima: Colima; 3.5 km ESE Estancia; 3 km SE Colima; 3 mi SE Colima; 4 mi SE Colima. Sample 44 -- Colima: 4 km SSW Colima; Las Lomas; 4 mi SW Colima. Sample 45 -- Colima: 15 km SSW Colima; 3 km SE Ortices. Sample 46 -- Colima: 22 km SSW Colima; 23 km SSW Colima; 27 km SSW Colima; 33.5 km SSW Colima. Sample 47 -- Colima: 10 km SE Colima; 3 km E Tecuizitan. Sample 48 -- Jalisco: 28 km S Atenquique. Sample 49 -- Colima: 5 km S Alzada; 4 mi E Trapichillos; Trapichillos. Sample 50 -- Colima: 3 mi E Ixtlahuacan. Sample 51 -- Colima: 12.5 mi SE Los Tepames. Sample 52 -- Jalisco: 14.5 mi S Pihuamo. Sample 53 -- Jalisco: 8 mi E Jilotlan; Jilotlan. Sample 54 -- Michoacan: Los Reyes. Sample 55 -- Michoacan: 10 km W Apatzingan; Apatzingan; 10 mi S, 1 mi W Apatzingan. Sample 56 -- Michoacan: 7 mi S Tumbiscatio. Sample 57 -- Michoacan: 16 mi S Arteaga; 1 mi E La Mira; 8 km N La Mira; 1 km N La Mira; 4 km N, 3 km W Playa Azul; 4 km N, 13 km W Playa Azul. Sample 58 -- Colima: 2 km NW Chiapa. Reference name and sample size are presented in Table 1.

When identification of specimens was unambiguous, grouped localities were assigned *a priori* to either (1) *L. p. pictus* or (2) *L. p. plantinarensis* as reference samples. Near the zone of contact where both taxa or intermediates were expected, grouped localities were

Fig. 1. Grouped localities of Liomys pictus. Sample numbers are defined in text and Table 1.


105
103
19
105
103
19
500 km
KILOMETERS
0
60

assigned to an "unclassified" category (3). For the unclassified localities, individuals were treated as operational taxonomic units (OTU's) in multivariate analyses (see Table 1).

For each quantitative variable in each grouped locality, standard statistics were calculated using the procedure MEANS. For each character, the GLM procedure was used to perform a single-classification, model I Anova to test for significant differences among localities. In the univariate analyses, grouped localities near the zone of contact were not included because the assumption of homoscedasticity would have been violated. A single-classification, model I MANOVA was used to test for significance of the locality effect across all characters. Procedure NESTED was used to perform a model II, two-level nested Anova in which the effect of group locality was subordinated and nested within the effect of *a priori* subspecific allocation.

Procedure FREQ was performed on the qualitatively assessed characters to obtain frequency distributions of the different character states within *L. p. pictus* and *L. p. plantinarensis*.

Table 1. Grouped locality, sample size, location, and subspecific assignment of populations of Liomys pictus in the study area. pic. = L. p. pictus, plan. = L. p. plantinarensis, unclass. = unclassified localities (individuals treated as OTU's).

GROUPED LOCALITY	N	LOCATION	SUBSPECIES
1	8	North Chamela, Jal.	pic. (1)
2	93	Chamela, Jal.	pic. (1)
3	31	Purificacion, Jal.	pic. (1)
4	64	San Patricio, Jal.	pic. (1)
5	14	Melaque, Jal.	pic. (1)
6	26	Autlan, Jal.	pic. (1)
7	17	Barra de Navidad, Jal.	pic. (1)
8	22	Cihuatlan, Jal.	pic. (1)
9	3	6 mi E El Limon	unclass.
10	9	14 km S Durazno	unclass.
11	9	Santiago, Col.	pic. (1)
12	2	7 mi SE Tapalpa, Jal.	pic. (1)
13	9	Comatlan, Col.	pic. (1)
14	6	Minatitlan, Col.	pic. (1)
15	26	30 km NNE Manzanillo, Col.	unclass.
16	4	2 mi NE Camotlan, Col.	pic. (1)
17	3	34 km NW Colima, Col.	unclass.
18	11	29.5 km NW Colima, Col.	unclass.
19	20	11 mi W Comala, Col.	unclass.
20	9	22 km NW Colima, Col.	unclass.
21	42	San Antonio, Col.	pic. (1)
22	14	La Cofradia, Col.	pic. (1)
23	8	17 km NW Colima, Col.	unclass.
24	8	13 km NW Colima, Col.	unclass.
25	26	Pueblo Juarez, Col.	pic. (1)
26	11	Cuyutlan, Col.	pic. (1)
27	19	Zapoltitic, Jal.	plan. (2)
28	2	9.8 mi W Atenquique, Jal.	pic. (1)
29	32	Queseria, Col.	pic. (1)
30	10	14.5 mi N Colima, Col.	unclass.
31	11	Comala, Col.	unclass.
32	17	Rincon de Lopez, Col.	pic. (1)
33	39	Armeria, Col.	pic. (1)
34	32	Contla, Jal.	plan. (2)
35	18	San Mames, Jal.	plan. (2)
36	5	Tuxpan, Jal.	plan. (2)
37	18	Platanar, Jal.	plan. (2)
38	18	2 km NE San Marcos, Jal.	unclass.
39	12	5 km SW San Marcos, Jal.	unclass.
40	1	9 mi NNE Colima, Col.	plan. (2)
41	212	El Cobano, Col.	unclass.

Table 1. Continued.

SAMPLE NUMBER	N	LOCATION	SUBSPECIES
42	5	Alzada, Col.	unclass.
43	35	Estancia, Col.	unclass.
44	4	Las Lomas, Col.	unclass.
45	20	Ortices, Col.	unclass.
46	21	South Colima, Col.	plan. (2)
47	20	Tecuizitan, Col.	plan. (2)
48	6	28 km S Atenquique, Jal.	unclass.
49	7	Trapichillos, Col.	plan. (2)
50	7	3 mi E Ixtlahuacan, Col.	pic. (1)
51	2	12.5 mi SE Tepames, Col.	pic. (1)
52	5	14.5 mi S Pihuamo, Jal.	plan. (2)
53	15	Jilotlan, Jal.	plan. (2)
54	11	Los Reyes, Mich.	plan. (2)
55	27	Apatzingan, Mich.	plan. (2)
56	5	Tumbiscatio, Mich.	unclass.
57	29	La Mira, Mich.	pic. (1)
58	49	2 km NW Chiapa, Col.	unclass.

Procedure PRINCOMP was used to perform a Principal Components Analysis (PCA) on the character correlation matrix of population means for the reference grouped localities assigned, a priori, to either subspecies, to obtain principal axes which summarize the directions of greatest variation among these samples. Scores for each sample were plotted on the first two component axes to depict the among sample variation. A second analysis was then performed including all "unclassified" specimens as OTU's to depict their position relative to the reference samples. Discriminant Function Analyses were performed to maximally separate the a priori designated reference samples, and specimens not previously assigned to either subspecies were entered as unknowns for tentative identification. These analyses included procedures CANDISC, and NEIGHBOR.

RESULTS

Nongeographic Variation.- Patterns of within sample variation were estimated in a sample of 118 individuals of Liomys pictus from near Chamela, Jalisco, Mexico (sample 2). Student's t-test was used to test for significant differences between sexes in each age class. Age class I was not included because no males of this age class were available. Although males averaged larger than females for almost all characters, significant differences were found in only five of 90 cases (Table 2). This proportion is close to the number expected by chance ($P<0.05$). Significant differences between sexes were found in GLS, LR, and BM for age class III, GLS in age class V, and TLT in age class VI. Because sexual dimorphism was not significant for most variables in all age classes, sexes were pooled in the analysis of age variation.

Single-classification ANOVA revealed significant differences among age classes for 15 of 18 characters (Table 3). Characters found not to vary significantly with age were LHF, IL, and PPW. Most characters appeared to

Table 2. Secondary sexual variation in each age class of *Liomys pictus* from near Chamela, Jalisco, Mexico.

CHAR.	SEX	AGE CLASSES II	III	IV	V	VI
				MEANS		
TL	M	208.2	228.7	230.8	237.4	240.7
	F	207.5	230.5	227.8	226.0	235.6
LT	M	106.5	117.3	117.0	119.8	120.1
	F	106.3	118.5	118.9	118.0	122.1
LHF	M	26.7	28.6	28.6	27.0	28.0
	F	27.5	27.5	28.5	27.2	27.9
LE	M	14.0	14.7	16.2	14.6	15.2
	F	14.07	14.60	15.55	14.88	15.36
GLS	M	29.35	31.20	31.20	32.04	32.20
	F	29.13	30.53 *	30.85	31.26 *	31.83
ZB	M	13.59	14.56	14.60	14.78	15.10
	F	13.66	14.32	14.44	14.51	14.83
POC	M	7.35	7.75	7.65	7.85	8.10
	F	7.31	7.57	7.88	7.72	7.87
MB	M	14.19	14.39	14.58	14.59	14.61
	F	14.03	14.25	14.25	14.35	14.62
LN	M	11.69	12.78	13.00	13.40	13.73
	F	11.58	12.65	12.63	12.93	13.43
LPM	M	12.35	13.39	13.54	14.07	14.19
	F	12.04	13.24	13.25	13.55	14.00
LR	M	12.50	13.77	13.81	14.11	14.17
	F	12.38	13.29 *	13.59	13.67	14.10
IW	M	8.09	8.83	8.95	8.64	8.83
	F	8.58	8.68	8.79	8.57	9.01
IL	M	4.40	4.61	4.55	4.65	4.59
	F	4.35	4.40	4.48	4.36	4.62

Table 2. Continued.

CHAR.	SEX	AGE CLASSES II	III	IV	V	VI
			MEANS			
LMT	M	4.85	5.06	4.93	5.02	4.91
	F	4.84	4.94	5.10	4.96	4.93
TLT	M	13.50	14.43	14.34	14.78	15.11
	F	13.55	14.16	14.34	14.46	14.67 *
BM	M	5.51	5.88	5.73	5.89	5.87
	F	5.51	5.67 *	5.83	5.89	5.90
PPW	M	5.26	5.26	5.29	5.27	5.17
	F	5.23	5.15	5.18	5.20	5.20
DBC	M	9.68	9.99	10.03	10.08	10.24
	F	9.77	9.83	10.07	9.99	10.06

Table 3. Age variation in 18 external and cranial measurements of *Liomys pictus* from the vicinity of Chamela, Jalisco, Mexico.

AGE CLASS	N	MEAN (RANGE) ± 2 SE	CV
Total length			
VI	15	238.0 (218 - 257) ± 5.26	4.28
III	24	229.8 (190 - 302) ± 8.38	8.93
IV	13	229.0 (218 - 242) ± 4.20	3.31
V	22	228.5 (202 - 260) ± 5.12	5.26
II	18	207.7 (185 - 222) ± 4.84	4.94
I	1	176.0	
		F = 11.79 ***	
Length of tail			
VI	15	121.2 (110 - 134) ± 3.78	6.06
V	22	118.4 (110 - 134) ± 3.02	6.00
IV	13	118.1 (110 - 126) ± 2.80	4.30
III	24	118.0 (80 - 135) ± 4.50	9.35
II	18	106.3 (93 - 118) ± 3.18	6.36
I	1	91.0	
		F = 9.15 ***	
Length of hind foot			
IV	14	28.5 (27 - 31) ± 0.74	4.89
III	27	27.9 (25 - 31) ± 0.66	6.23
VI	19	27.9 (25 - 31) ± 0.72	5.65
II	18	27.3 (24 - 31) ± 0.92	7.20
V	23	27.1 (24 - 31) ± 0.88	7.07
I	1	27.0	
		F = 1.47 ns	
Length of ear			
IV	14	15.7 (14 - 17) ± 0.46	5.65
VI	19	15.3 (13 - 18) ± 0.54	7.86
V	22	14.8 (12 - 18) ± 0.74	11.89
III	26	14.6 (11 - 17) ± 0.54	9.64
II	18	14.0 (12 - 18) ± 0.72	11.04
I	1	14.0	
		F = 2.88 *	

Table 3. Continued

AGE CLASS	N	MEAN (RANGE) ± 2 SE	CV
		Greatest length of skull	
VI ¦	20	32.00 (30.90 - 34.55) ± 0.36	2.54
V ¦¦	23	31.46 (30.40 - 33.55) ± 0.34	2.59
IV ¦¦	16	30.98 (29.50 - 32.25) ± 0.40	2.66
III ¦	30	30.77 (28.00 - 32.25) ± 0.32	2.89
II ¦	17	29.20 (27.60 - 30.65) ± 0.36	2.57
I ¦	3	26.90 (26.30 - 27.30) ± 0.60	1.96
		F = 37.68 ***	
		Zygomatic breadth	
VI ¦	17	14.96 (14.40 - 16.20) ± 0.22	3.03
V ¦	20	14.57 (14.05 - 15.40) ± 0.18	2.97
IV ¦	16	14.50 (13.85 - 15.30) ± 0.20	2.86
III ¦	23	14.42 (13.50 - 15.40) ± 0.20	3.41
II ¦	19	13.65 (12.80 - 14.90) ± 0.24	3.91
I ¦	3	12.73 (12.20 - 13.45) ± 0.74	5.06
		F = 22.45 ***	
		Postorbital constriction	
VI ¦	20	7.97 (7.30 - 8.50) ± 0.14	3.99
IV ¦	16	7.79 (7.00 - 8.45) ± 0.20	5.27
V ¦	25	7.75 (7.00 - 8.35) ± 0.12	4.10
III ¦¦	31	7.64 (6.85 - 8.55) ± 0.12	4.64
II ¦¦	22	7.32 (6.95 - 7.65) ± 0.08	2.96
I ¦	3	7.11 (6.65 - 7.50) ± 0.48	6.05
		F = 10.80 ***	
		Mastoid breadth	
VI ¦	20	14.61 (13.50 - 15.50) ± 0.18	2.94
V ¦	23	14.41 (13.70 - 15.00) ± 0.14	2.48
IV ¦	16	14.37 (13.65 - 15.10) ± 0.22	3.27
III ¦	32	14.30 (13.05 - 15.40) ± 0.16	3.46
II ¦	17	14.07 (13.50 - 14.60) ± 0.16	2.36
I ¦	3	13.53 (13.25 - 13.70) ± 0.28	1.82
		F = 5.30 ***	

Table 3. Continued

AGE CLASS	N	MEAN (RANGE) ± 2 SE	CV
		Length of nasal	
VI	20	13.57 (12.00 - 14.60) ± 0.24	4.18
V	25	13.04 (12.10 - 15.00) ± 0.26	5.17
IV	16	12.76 (11.60 - 13.70) ± 0.34	5.33
III	30	12.70 (11.00 - 14.60) ± 0.24	5.52
II	22	11.61 (10.65 - 12.70) ± 0.26	5.35
I	3	10.00 (9.45 - 10.55) ± 0.62	5.50
		F = 30.78 ***	
		Length of premaxillary	
VI	20	14.09 (12.75 - 16.15) ± 0.32	5.09
V	25	13.68 (12.80 - 15.35) ± 0.26	4.77
IV	16	13.35 (12.40 - 14.20) ± 0.28	4.48
III	30	13.30 (11.70 - 15.50) ± 0.26	5.44
II	22	12.14 (10.90 - 13.50) ± 0.26	5.05
I	3	10.86 (10.40 - 11.30) ± 0.52	4.15
		F = 28.40 ***	
		Length of rostrum	
VI	20	14.13 (13.15 - 15.55) ± 0.26	4.33
V	25	13.77 (12.95 - 15.15) ± 0.22	4.20
IV	16	13.67 (12.60 - 14.55) ± 0.28	4.26
III	30	13.47 (12.00 - 14.35) ± 0.18	3.81
II	22	12.42 (11.70 - 13.40) ± 0.20	4.14
I	3	11.05 (10.85 - 11.35) ± 0.30	2.39
		F = 34.93 ***	
		Interparietal width	
VI	19	8.93 (7.90 - 9.90) ± 0.24	6.12
IV	16	8.85 (7.90 - 9.60) ± 0.24	5.43
III	31	8.74 (7.85 - 9.60) ± 0.14	4.49
V	23	8.58 (7.80 - 9.50) ± 0.18	5.41
I	3	8.46 (7.70 - 8.95) ± 0.76	7.93
II	19	8.42 (6.75 - 9.50) ± 0.28	7.39
		F = 2.67 *	

Table 3. Continued

AGE CLASS	N	MEAN (RANGE) ± 2 SE	CV
		Interparietal length	
VI ¦	19	4.60 (3.95 - 5.10) ± 0.14	6.98
IV ¦	16	4.50 (3.90 - 5.20) ± 0.18	8.09
III ¦	31	4.48 (4.00 - 5.25) ± 0.10	7.10
I ¦	3	4.48 (4.45 - 4.50) ± 0.02	0.64
V ¦	23	4.42 (3.95 - 5.15) ± 0.12	6.73
II ¦	19	4.37 (3.85 - 5.15) ± 0.16	8.35
		F = 1.15 ns	
		Length of maxillary toothrow	
IV ¦	16	5.04 (4.40 - 5.70) ± 0.12	5.31
III ¦	30	4.98 (4.50 - 5.45) ± 0.08	4.61
V ¦	24	4.97 (4.60 - 5.55) ± 0.08	3.96
VI ¦¦	20	4.92 (4.35 - 5.25) ± 0.08	4.14
II ¦¦	22	4.84 (4.45 - 5.15) ± 0.06	3.56
I ¦	3	4.66 (4.45 - 4.80) ± 0.20	4.05
		F = 2.94 *	
		Total length of toothrow	
VI ¦	20	14.87 (14.30 - 15.95) ± 0.20	3.13
V ¦¦	24	14.52 (13.70 - 15.20) ± 0.14	2.36
IV ¦	16	14.34 (13.50 - 15.10) ± 0.20	2.94
III ¦	30	14.26 (13.10 - 14.90) ± 0.14	2.86
II ¦	22	13.53 (12.35 - 14.20) ± 0.18	3.45
I ¦	3	12.46 (12.15 - 12.80) ± 0.36	2.61
		F = 34.59 ***	
		Breadth across molars	
V ¦	23	5.89 (5.50 - 6.25) ± 0.08	3.37
VI ¦	20	5.89 (5.45 - 6.35) ± 0.08	3.56
IV ¦¦	15	5.79 (5.55 - 6.15) ± 0.08	3.10
III ¦¦¦	31	5.75 (5.00 - 6.25) ± 0.10	5.06
II ¦¦	22	5.51 (5.20 - 5.90) ± 0.08	3.75
I ¦	3	5.48 (5.40 - 5.60) ± 0.12	1.89
		F = 8.91 ***	

Table 3. Continued

AGE CLASS	N	MEAN (RANGE) ± 2 SE	CV
		Postdental palate width	
I	3	5.40 (5.30 - 5.50) ± 0.10	1.85
II	22	5.24 (4.90 - 5.70) ± 0.08	3.90
IV	16	5.22 (4.80 - 5.65) ± 0.10	4.09
V	25	5.22 (4.90 - 5.70) ± 0.08	3.88
III	32	5.19 (4.50 - 5.65) ± 0.08	4.40
VI	20	5.19 (4.85 - 5.65) ± 0.08	4.01
		F = 0.62 ns	
		Depth of brain case	
VI	20	10.14 (9.80 - 10.60) ± 0.10	2.51
IV	16	10.05 (9.60 - 10.45) ± 0.12	2.52
V	22	10.01 (9.40 - 10.55) ± 0.12	3.19
III	30	9.90 (9.30 - 10.45) ± 0.08	2.42
II	19	9.74 (9.40 - 10.10) ± 0.08	1.97
I	3	9.33 (9.15 - 9.45) ± 0.18	1.72
		F = 9.41 ***	

increase in size with age. Results from an *a posteriori* Tukey-Kramer Multiple Range Test showed that age classes I and II differed significantly from the other age classes for seven characters (GLS, ZB, POC, LN, LPM, LR, and TLT). Overlapping subsets including age classes III to VI were found for 10 characters (TL, GLS, ZB, POC, LN, LPM, LR, TLT, BM, and DBC). Consequently age classes III to VI were considered to form a homogeneous subset.

Results from a two-way MANOVA confirmed results obtained by both the t-test and single-classification ANOVA. Sixty-four individuals were used in this analysis because specimens with missing values were excluded. When all age classes were included, the effect of sex was not significant for any of the criteria of MANOVA, whereas overall age effect was significant for the Wilks' criterion and the Hotelling-Lawley trace. A two-way MANOVA also was performed on a subset including only age classes III to VI. Neither the effect of sex nor age was significant for this subset of age classes.

Procedure VARCOMP was performed to estimate the relative contribution of sex, age, sex by age interaction, and error to a two-way ANOVA from variance components. Separate analyses with sex entered first, or age entered first rendered almost identical results, and therefore

only results with sex entered first are presented (Table 4). Most of the variation encountered is attributable to age and error (average 95%). However, error contributed the largest component of variation (71.5% on average), whereas age had an average contribution of 23.5%. Sex and sex by age interaction contributed only an average of 5% of the total variation.

Variance components also were estimated from a two-way ANOVA restricted to age classes III through VI (Table 5). In this restricted analysis, the relative contribution of error increased to an average of 83% of the total variation. Age effect contributed only 10% of the total variation, sex 4.9% and sex by age interaction 1.8%.

Traditionally age class III (Genoways, 1973; Rogers and Schmidly, 1982; Engstrom, et al., in press) or equivalents such as young adults (Desha, 1967; Schmidly and Hendricks, 1976; Baumgardner and Schmidly, 1981) have been ommitted in studies of geographic variation in heteromyid rodents. Therefore, variance components were estimated also from a two-way ANOVA restricted to age classes IV to VI. Results (Table 5) were similar to those obtained from age classes III to VI. Consequently, age classes III to VI were pooled in analyses of geographic

Table 4. Percentage of total variation attributable to sex (S), age (A), sex by age interaction (SXA), and error (E) for age classes I-VI in Liomys pictus from near Chamela, Jalisco, Mexico.

Characters	Variance components			
	S	A	SXA	E
TL	5.76	31.65	0.0	62.58
LT	0.0	26.77	0.58	72.63
LHF	0.60	4.84	0.0	94.54
LE	0.01	12.19	0.0	87.79
GLS	10.52	41.22	0.0	48.24
ZB	5.26	42.10	0.0	52.63
POC	4.45	25.47	0.0	70.06
MB	8.33	12.50	0.0	79.16
LN	6.72	42.85	0.0	50.42
LPM	6.89	43.96	0.0	49.13
LR	8.69	44.56	0.0	46.73
IW	0.0	7.40	0.0	96.59
IL	7.33	0.91	0.0	91.74
LMT	0.0	4.70	1.17	94.11
TLT	7.54	45.28	0.0	47.16
BM	0.0	14.92	10.44	74.62
PPW	0.99	0.0	0.0	99.00
DBC	5.26	21.05	0.0	73.68
MEAN	4.35	23.46	0.67	71.48

Table 5. Percentage of total variation attributable to sex (S), age (A), sex by age interaction (SXA), and error (E) for age classes III-VI and IV-VI in Liomys pictus from near Chamela, Jalisco, Mexico.

Char.	variance components							
	S	A (III - VI)	SXA	E	S	A (IV - VI)	SXA	E
TL	2.75	3.00	2.75	94.23	12.05	17.49	3.69	66.76
LT	0.0	1.43	0.0	98.56	0.0	2.24	0.0	97.75
LHF	1.90	5.07	0.0	93.01	0.0	14.04	0.0	85.95
LE	0.0	9.60	0.0	90.39	0.0	10.43	0.0	89.55
GLS	14.01	27.10	0.0	58.87	14.00	22.00	0.0	64.00
ZB	10.71	17.85	0.0	71.42	14.28	21.42	0.0	64.28
POC	1.56	7.81	4.68	85.93	0.0	3.25	7.31	89.43
MB	4.76	4.76	0.0	90.47	5.64	3.95	0.0	93.90
LN	7.69	24.61	0.0	67.69	14.28	22.22	0.0	63.49
LPM	6.15	20.00	0.0	72.30	10.16	16.94	0.0	72.88
LR	10.00	15.00	2.50	72.50	7.31	9.75	0.0	82.92
IW	0.13	4.53	0.0	95.32	0.0	7.69	0.0	92.30
IL	8.73	0.0	3.88	87.37	0.90	0.0	8.18	90.90
LMT	0.0	0.0	4.76	95.23	0.0	0.0	1.23	98.76
TLT	12.00	28.00	0.0	60.00	16.00	24.00	0.0	60.00
BM	0.0	0.0	16.66	83.33	1.63	4.68	0.0	93.67
PPW	2.43	0.0	0.0	97.56	0.04	0.0	0.0	99.95
DBC	5.47	12.32	0.0	82.19	4.00	2.66	0.0	93.33
MEAN	4.90	10.06	1.80	83.13	5.57	10.15	1.13	83.32

variation. Sex contributed a relatively small proportion of the variance in all tests, and therefore, sexes also were pooled in the geographic analyses.

Most characters displayed coefficients of variation (C.V.) within the range previously noted by Genoways (1973) for this species. External measurements tended to be more variable than cranial measurements, although interparietal length (IL) was the most variable character (see sample 2, Appendix II). External measurements were excluded from multivariate analyses of geographic variation because their variability is usually associated with the difference in measuring techniques among preparators. However, IL was retained because this variable was originally used to differentiate L. pictus from L. plantinarensis (Merriam, 1902).

Geographic variation: Univariate analyses.-- Standard statistics (sample size, mean, range, standard deviation, and coefficient of variation) were obtained for each character in each group locality and are presented in appendix II. Coefficients of variation (C.V.'s) tended to be higher for external measurements, but IL showed the highest CV in several grouped localities.

Reference grouped localities were assigned *a priori* to either (1) *L. p. pictus* or (2) *L. p. plantinarensis*, based on characters used in the original description of *plantinarensis* and those used by Genoways (1973). Grouped localities near the zone of contact, where both taxa or intermediates were expected, were assigned to an "unclassified" (3) category, and individuals from these localities were treated as separate OTU's in multivariate analyses. Grouped locality identification number, sample size, location, and taxonomic assignation are presented in Table 1. Mean, range, standard error, and coefficient of variation for each character in each grouped locality are given in appendix 2. After excluding the "unclassified" localities, all characters varied significantly among reference grouped localities at $P<0.001$, by ANOVA.

Nested Analysis of Variance was used to analyze the hierarchical effects of variation among subspecies and variation among grouped localities within subspecies. Subspecific allocation was considered a random effect. By variance partitioning, percentage contributions for each effect and error were estimated (Table 6). Of the 14 characters analyzed, IL showed the largest variance component attributable to variation among subspecies. For GLS, ZB, MB, LN, LR, and TLT more than 50% of variation was attributable to subspecific allocation, whereas IW

Table 6. Percentage of total variation attributable to subspecific allocation, grouped locality (GLOC), and error from a Nested Analysis of Variance for populations of *Liomys pictus* in the study area.

Characters	Variance components		
	SUBSPECIES	GLOC	ERROR
GLS	63.10	7.36	29.53
ZB	63.84	7.46	28.69
POC	44.19	11.70	44.09
MB	63.14	9.96	26.88
LN	53.79	9.54	36.66
LPM	42.06	11.52	46.41
LR	63.23	8.45	28.30
IW	3.85	19.24	76.89
IL	82.05	3.04	14.90
LMT	14.28	15.97	69.74
TLT	57.96	9.81	32.21
BM	15.72	7.44	76.83
PPW	28.06	5.97	65.96
DBC	45.01	10.92	44.05
MEAN	45.72	9.88	44.37

showed the least (3.9%). In contrast to the effect of subspecific assignment, variation among grouped localities within subspecies contributed a relatively minor component of the total variation to the model. For all characters, the percentage of variation attributable to the effect of locality within subspecies was less than that attributable to either subspecific allocation or error. Error accounted for more than 50% of the total variance for IW, LMT, BM, and PPW. Consequently, the majority of the variance among localities is due to differences between subspecies, and variation among localities within subspecies is relatively minor.

For the 14 cranial characters, a single-classification MANOVA was performed on all reference populations, and then again separately for each taxon. In both cases MANOVA revealed significant heterogeneity among grouped localities ($P<0.001$; Hotelling Lawley Trace, Pillali's Trace, Wilks' Criterion, and Roy's Maximum Root Criterion).

To analyze patterns of geographic variation within and between the two subspecies, a transect of selected grouped localities roughly running from NE to SW was constructed. This transect crosses the range of both taxa, including a broad area of overlap, and generally follows

Mexican Highway 110. This transect was originally suggested by Genoways (1973) to resolve the systematic relationship of these two taxa. The transect included the following samples: Los Reyes, Michoacan. (54); Contla, Jalisco. (34); San Mames, Jalisco. (35); Tuxpan, Jalisco. (36); Platanar, Jalisco. (37); 2 km NE San Marcos, Jalisco. (38); 5 km SW San Marcos, Jalisco. (39); 2 km NW Chiapa, Colima. (58); El Cobano, Colima. (41); Comala, Colima. (31); 13 km NW Colima, Colima. (24); 11 mi W Comala, Colima. (19); Estancia, Colima. (43); Las Lomas, Colima. (44); Ortices, Colima. (45); South Colima, Colima. (46); 30 km NNE Manzanillo, Colima. (15); Pueblo Juarez, Colima. (25); Armeria, Colima. (33); Santiago, Colima. (11); Cihuatlan, Jalisco. (8); Chamela, Jalisco. (2).

Patterns of variation for individual characters along the transect were analyzed by means of Hubbs and Hubbs diagrams for selected characters (Figs. 2 and 3). The first five samples (54, 34, 35, 36, 37) and sample 46, correspond to reference populations of L. p. plantinarensis, whereas the last five samples (25, 33, 11, 8, 2) correspond to reference populations of L. p. pictus. Comparing only the reference samples, there is a clear difference in size between both taxa for most characters analyzed. L. p. plantinarensis is smaller in size for most characters than L. p. pictus (see also Genoways, 1973).

Fig. 2. Hubbs and Hubbs diagrams for greatest length of skull (GLS), zygomatic breadth (ZB), and mastoid breath (MB) for samples of Liomys pictus along a northeast to southwest transect in Colima and southern Jalisco. Horizontal line represents the range; vertical line, the mean; open rectangle, one standard deviation; and closed rectangle, two standard errors of the mean. Numbers to the left correspond to grouped locality, and numbers to the right to sample size.

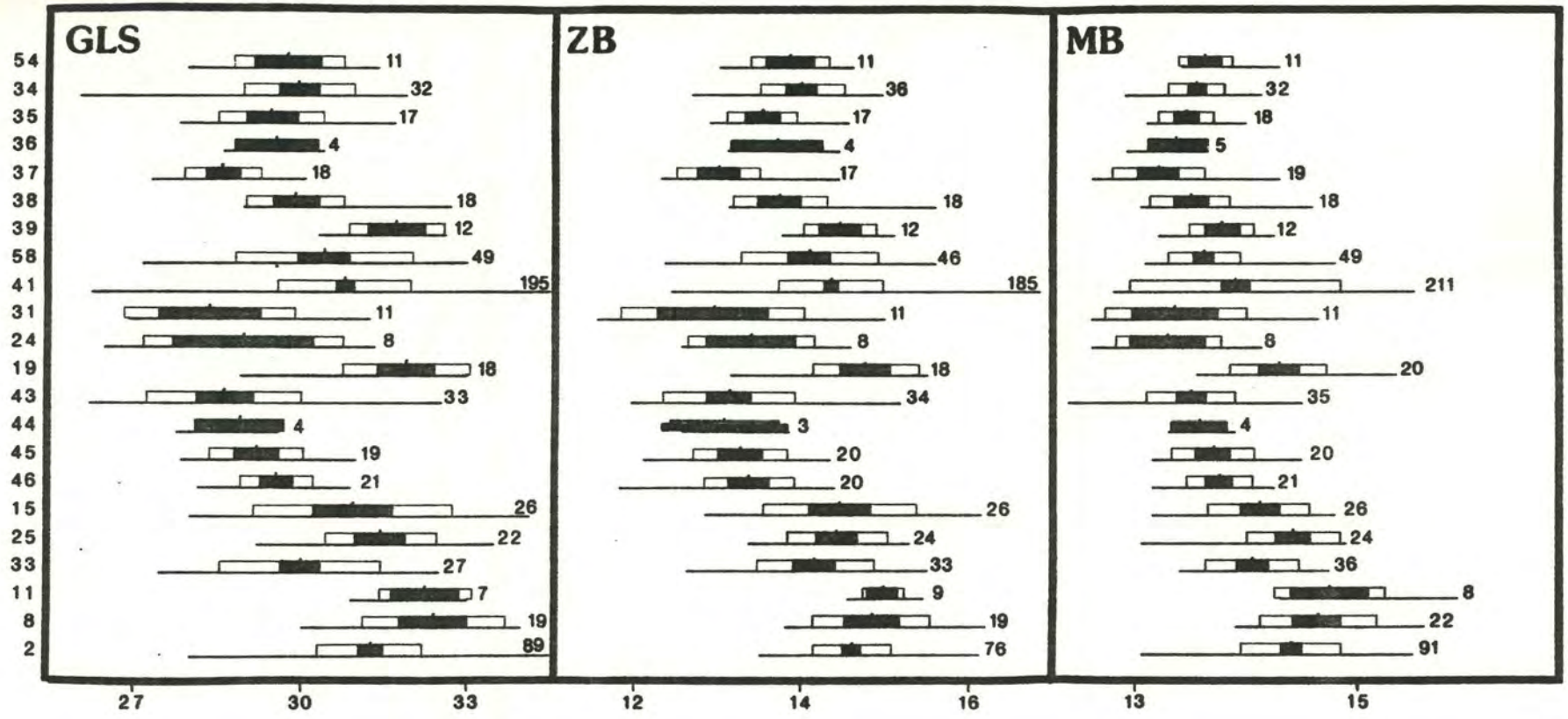
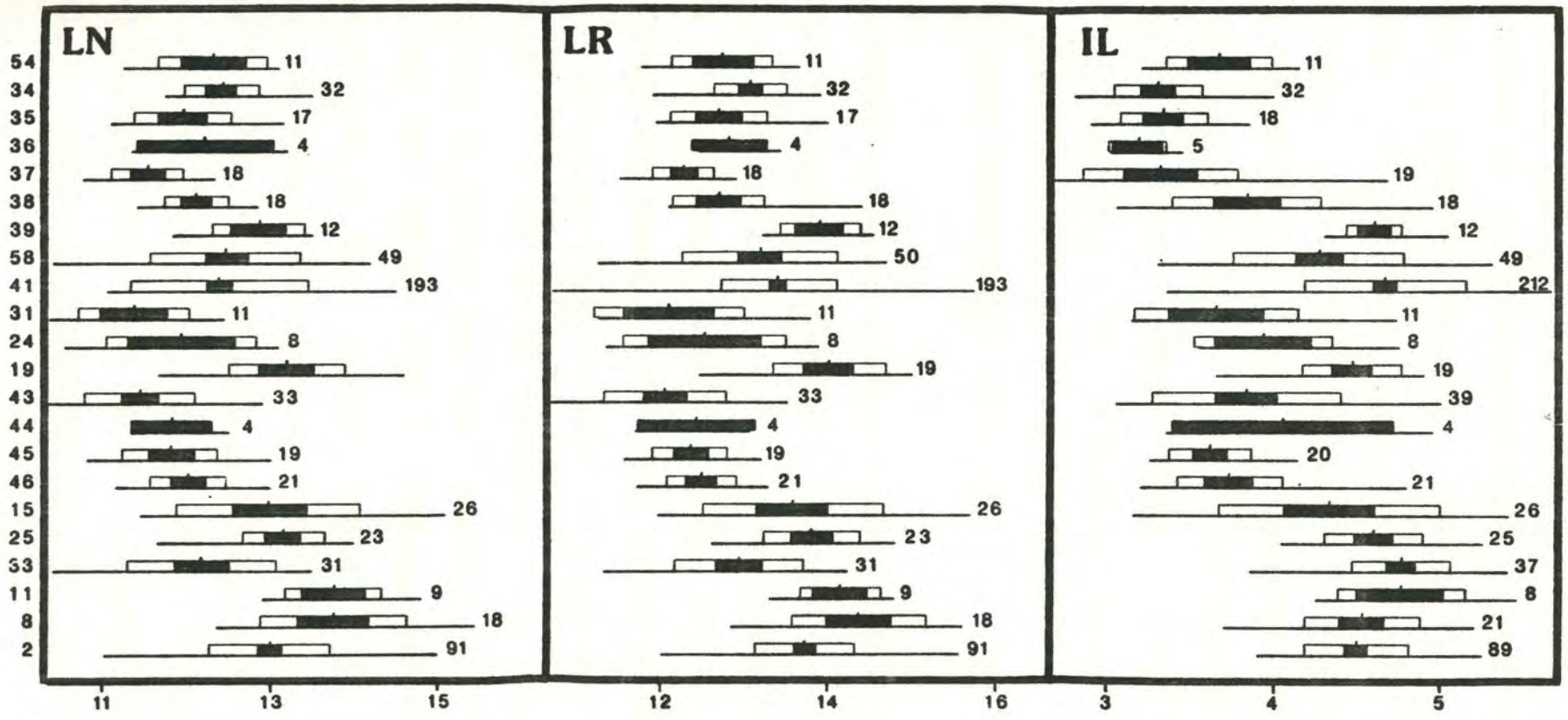

GLS
ZB
MB
54 11
34 32
35 17
36 4
37 18
38 18
39 12
58 49
41 195
31 11
24 8
19 18
43 33
44 4
45 19
46 21
15 26
25 22
33 27
11 7
8 19
2 89
11
36
17
4
17
18
12
46
185
11
8
18
34
3
20
20
26
24
33
9
19
76
11
32
18
5
19
18
12
49
211
11
8
20
35
4
20
21
26
24
36
8
22
91
27
30
33
12
14
16
13
15

Fig. 3. Hubbs and Hubbs diagrams for length of nasals (LN), length of rostrum (LR), and interparietal length (IL). See Fig. 2 for description of individual diagrams.


LN
LR
IL
54 11
34 32
35 17
36 4
37 18
38 18
39 12
58 49
41 193
31 11
24 8
19
43 33
44 4
45 19
46 21
15 26
25 23
33 31
11 9
8 18
2 91
11 32
32 17
17 4
4 18
18 18
18 12
12 50
50 193
193 11
11 8
8 19
19 33
33 4
4 19
19 21
21 26
26 23
23 31
31 9
9 18
18 91
11 32
32 18
18 5
5 19
19 18
18 12
12 49
49 212
212 11
11 8
8 19
19 39
39 4
4 20
20 21
21 26
26 25
25 37
37 8
8 21
21 89
11 13 15
12 14 16
3 4 5

However, populations in the contact zone had mean values corresponding to either pictus (e.g. samples 19, 39) or plantinarensis (e.g. samples 44, 45), whereas others appeared to fall in between. Nevertheless, a progressive increase in size from the smaller plantinarensis in the NE to the larger pictus in the SW, which would suggest simple clinal variation or broad intergradation, is not evident. Coefficients of variation (C.V.'s) from these mixed localities appear to be somewhat larger than the C.V.'s from the reference populations (Appendix 2).

Qualitatively assessed characters were not included in the detailed characterization of the contact zone. However, frequency distributions of the character states of PMI, and CPI, confirmed results obtained by Genoways (1973) for these subspecies. Using only the reference samples, the posterior margin of the interparietal (PMI) was notched in 26 (5.0%) of 517 specimens of L. p. pictus, slightly notched in 120 (23.2%) and unnotched in 371 (71.8%). In 202 individuals of L. p. plantinarensis, PMI was notched in 116 (57.4%), slightly notched in 62 (30.7%), and unnotched in 24 (11.9%). A Goodness of Fit test revealed significant differences between both subspecies ($P<0.001$). In L. p. pictus, the interparietal was divided in only 3 specimens (0.6%) and undivided in 516 (99.4%). In 207 L. p. plantinarensis, 26 (12.8%) had a

divided interparietal and 177 (87.2%) did not. A Goodness of Fit Test also showed significant differences between both taxa ($P<.01$) for this character. Specimens from the contact zone that were identified as one subspecies or the other in the Discriminant Function Analyses of quantitative characters (see below) had character state frequencies not significantly different from the corresponding reference morphotypes, as revealed by the Goodness of Fit Test ($P>0.05$). Individuals regarded as outliers, however, were significantly different than both reference morphotypes for these characters. Character state frequencies in this last group were as follows: PMI notched, 11 individuals (15.5%); slightly notched, 27 (38.0%); and unnotched, 33 (46.5%). COI was divided in 1 specimen (1.4%), and undivided in 70 (98.6%).

Although Genoways (1973) stated that the pelage coloration of the two subspecies usually is similar, a detailed analysis of the ochraceous lateral line which divides the dorsum from the venter, revealed qualitative differences between the taxa. Of 430 *L. p. pictus*, 223 (51.9%) had a brightly colored lateral line, and 63 (14.7%) had a relatively faint lateral line. Of 166 *L. p. plantinarensis*, the lateral line was faint or absent in 105 (63.3%), and only 10 specimens (6.0%) had a brightly colored lateral line. Intermediate shades were found in

144 (33.5%) specimens of L. p. pictus and 51 (30.7%) of L. p. plantinarensis. A Goodness of Fit Test revealed significant differences between the subspecies ($P<0.01$). Specimens from the contact zone assigned to either subspecies in Discriminant Function Analyses, were similar to one of the reference samples ($P>0.05$), whereas the outliers were significantly different than L. p. plantinarensis ($P<0.01$), but not L. p. pictus ($P>0.05$).

Geographic variation: Multivariate Analyses.-- Principal components analysis was performed on the correlation matrix of means for cranial characters of the reference samples to depict patterns of variation between the subspecies (Table 7; Fig. 4). The first two components accounted for 84.6% of the total variation. All characters were positively correlated with the first component axis; consequently, the samples separated on this axis on the basis of overall size. Because the two subspecies differ principally in size, separation between these taxa was most evident on the first axis (Fig. 4). Two major clusters of grouped localities were formed, one containing samples of the smaller L. p. plantinarensis, and one comprising samples of the larger L. p. pictus.

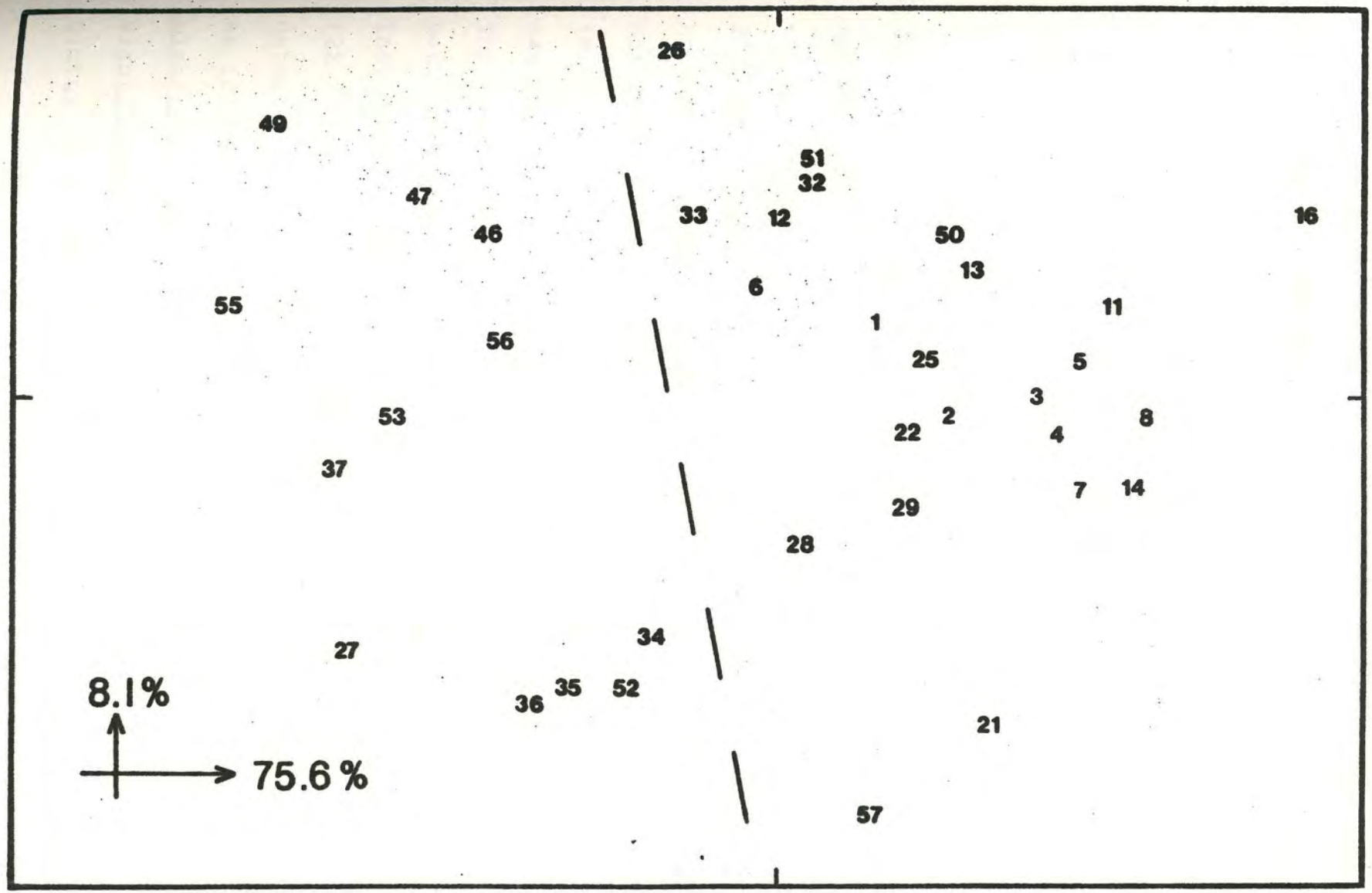
Table 7. Results of the principal components analysis on the reference samples of Liomys pictus from southern Jalisco and Colima.

	Eigenvalue	Proportion	Cumulative
PRIN1	10.5821	75.58 %	75.58 %
PRIN2	1.1314	8.08 %	83.66 %

EIGENVECTORS

	PRIN1	PRIN2
GLS	0.2998	0.0112
ZB	0.2954	0.0622
POC	0.2632	0.0670
MB	0.2862	0.2078
LN	0.2737	0.0742
LPM	0.2896	-0.0565
LR	0.2998	-0.0402
IW	0.1693	0.5988
IL	0.2403	0.3294
LMT	0.1996	-0.5893
TLT	0.2969	-0.0983
BM	0.2430	-0.2801
PPW	0.2586	-0.1855
DBC	0.2867	-0.0292

Fig. 4. Projections on the first two Principal Components of reference samples of L. p. pictus (right of dashed line) and L. p. plantinarensis (left of dashed line).


26
49
51
32
47
33
12
16
46
50
13
6
55
11
1
56
25
5
3
53
2
8
22
4
37
7
14
29
28
34
27
8.1%
35
52
36
21
75.6%
57

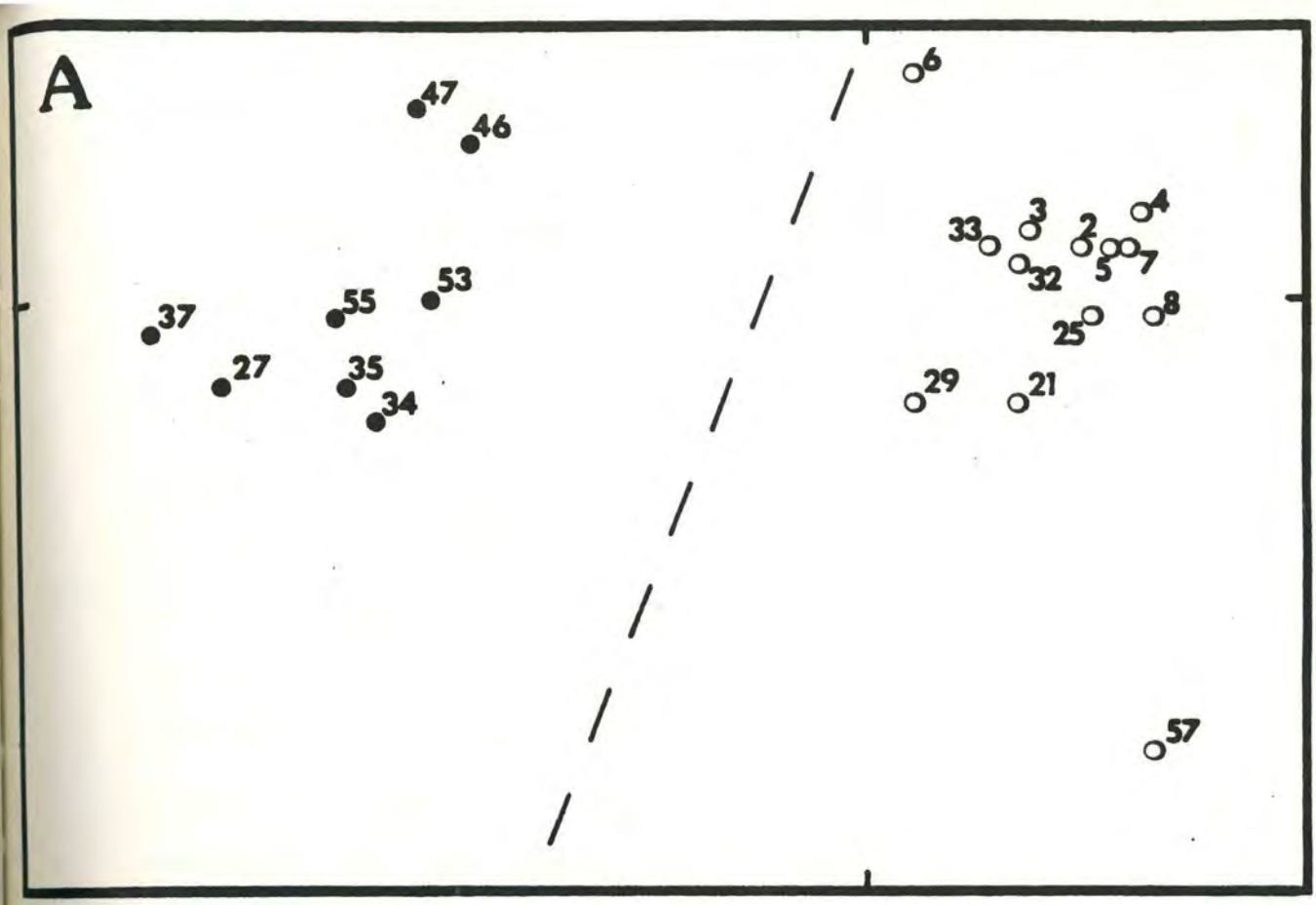
To depict trends of variation among the individuals from the contact zone, the "unclassified" specimens were included in a second PCA with the reference samples. Most of the "unclassified" individuals grouped with one or the other reference samples, however, there was no clear separation of OTU's into two groups.

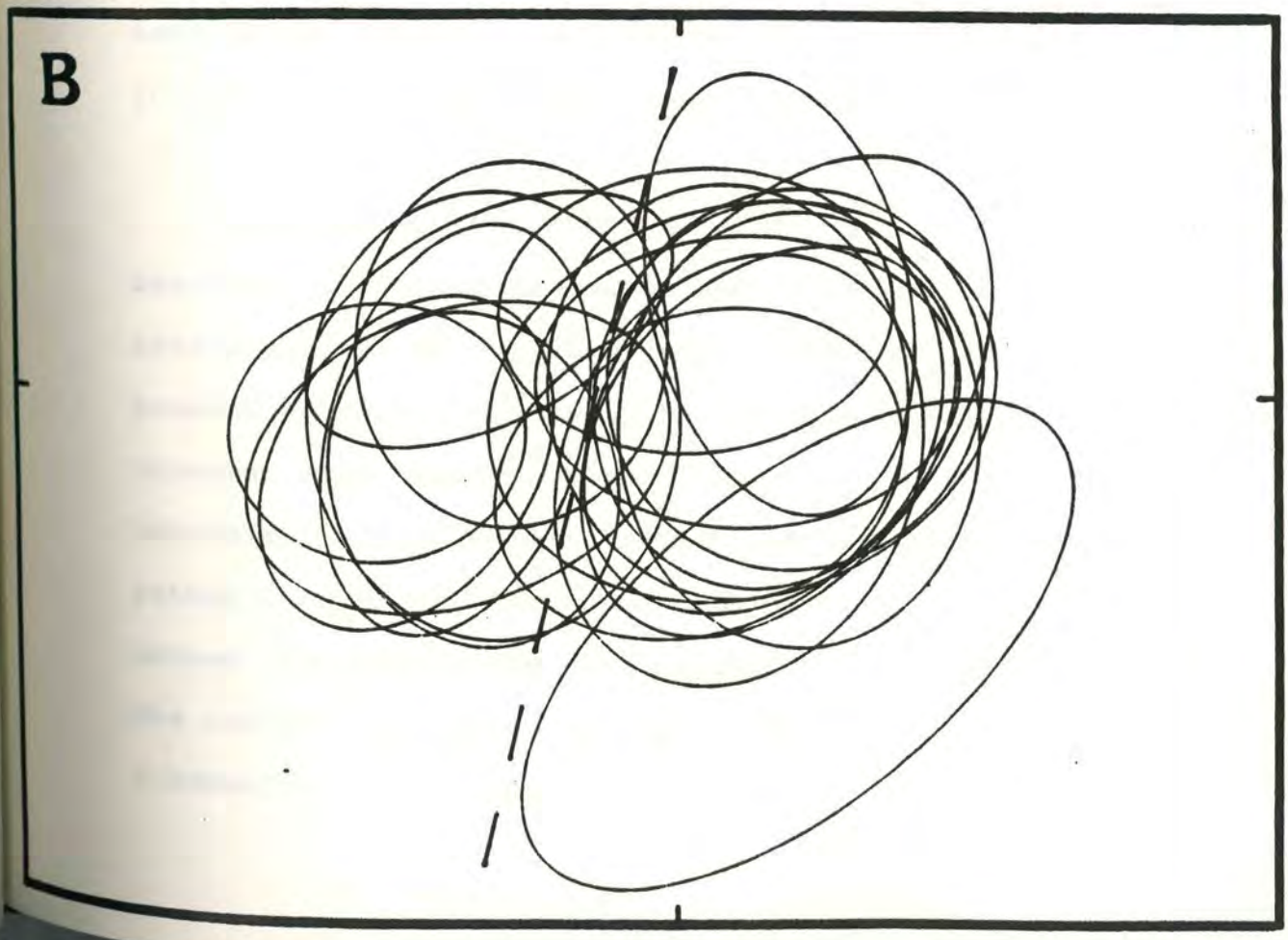
The "unclassified" individuals were tested against the reference samples using procedure NEIGHBOR, a nonparametric approach to discriminant function analysis which performs a nearest neighbor discriminant analysis. In this analysis, individuals are not necessarily assigned to one of the two reference groups. Individuals which do not meet the criteria for reference groups defined by the initial nearest neighbor discriminant analysis, are assigned to a third category of outliers labelled "other". The same probability of membership was established for both reference groups (P=0.5). Of the 408 unclassified individuals, 241 (59.1%) were assigned to L. p. pictus, 93 (22.8%) to L. p. plantinarensis, and 74 (18.7%) to the category "other". The "other" specimens were distributed as follows: 7 were very small (smaller than typical L. p. plantinarensis); 28 fell within the size range of L. p. plantinarensis; 27 fell within the size range of L. p. pictus; 2 were large (larger than typical L. p. pictus);

and 10 were specimens intermediate in size between the two taxa.

Procedure CANDISC was used to perform canonical discriminant analyses. Initially, reference samples were analyzed using the a priori subspecific allocation as the classification variable to depict the differences between the reference groups. The subspecies separated into two distinct groups along the first axis. To test the consistency of subspecific allocations and the homogeneity of the sample groupings, a second analysis was performed on the reference samples, using the grouped localities as the classification variable. Samples with less than ten individuals were excluded. A plot of the sample centroids on the first two canonical axes is given in Fig. 5A, and their corresponding 95 % confidence ellipses are presented in Fig. 5B (Owens and Chmielewski, 1985). Although sample centroids separate into two distinct groups, their corresponding 95% confidence ellipses overlap over a relatively broad area. Sample 57, from coastal southern Michoacan, assigned to L. p. pictus, separates somewhat along canonical axis II from other populations of L. p. pictus.

Fig. 5. A: Projections of the centroids on the first two canonical variates derived from the Canonical Variance Analysis for the reference samples of L. p. pictus (open circles) and L. p. plantinarensis (closed circles). B: Projections of 95% confidence ellipses on the first two canonical variates derived from a Canonical Variance Analysis for the reference samples of L. p. pictus (right of dashed line) and L. p. plantinarensis (left of dashed line).

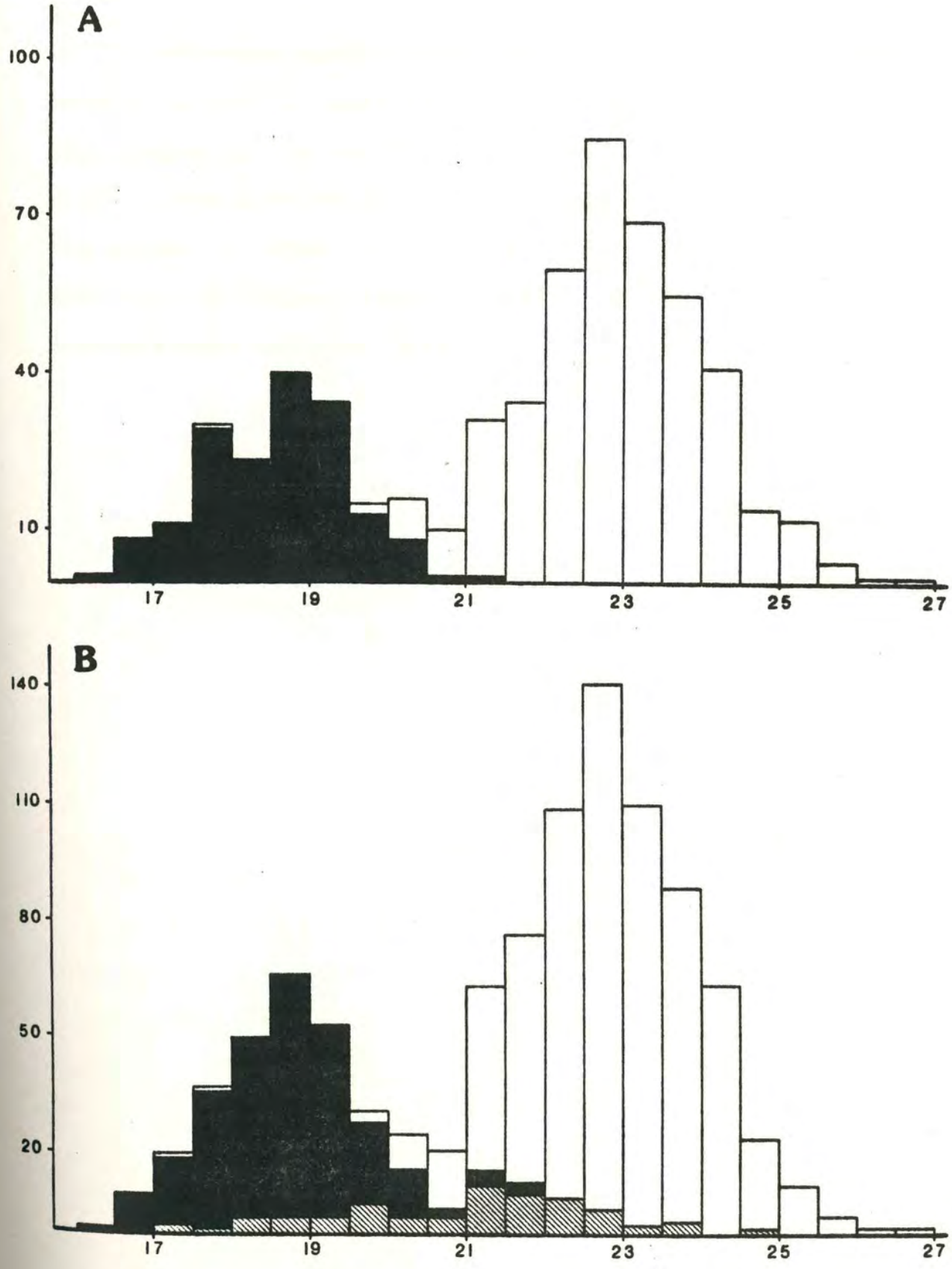

A
47
46
6
33
3
2
4
5
7
32
37
55
53
8
25
27
35
34
29
21
57


B

Discriminant multipliers from the first analysis, using subspecific allocation as the classification variable, were used to characterize all the individuals sampled, including unclassified specimens. Histograms of discriminant scores of the reference samples and unclassified individuals are presented in Fig. 6. Two groups corresponding to the reference samples were evident, although some overlap was present (Fig. 6A). Adding the z-values of the unclassified specimens also resulted in two relatively distinct groups (Fig. 6B). The outliers from the nonparametric nearest neighbor analysis, spread across the discriminant axis. Outliers included specimens with apparent affiliations to the reference samples and others which appeared as outliers to or intermediates between the reference samples.

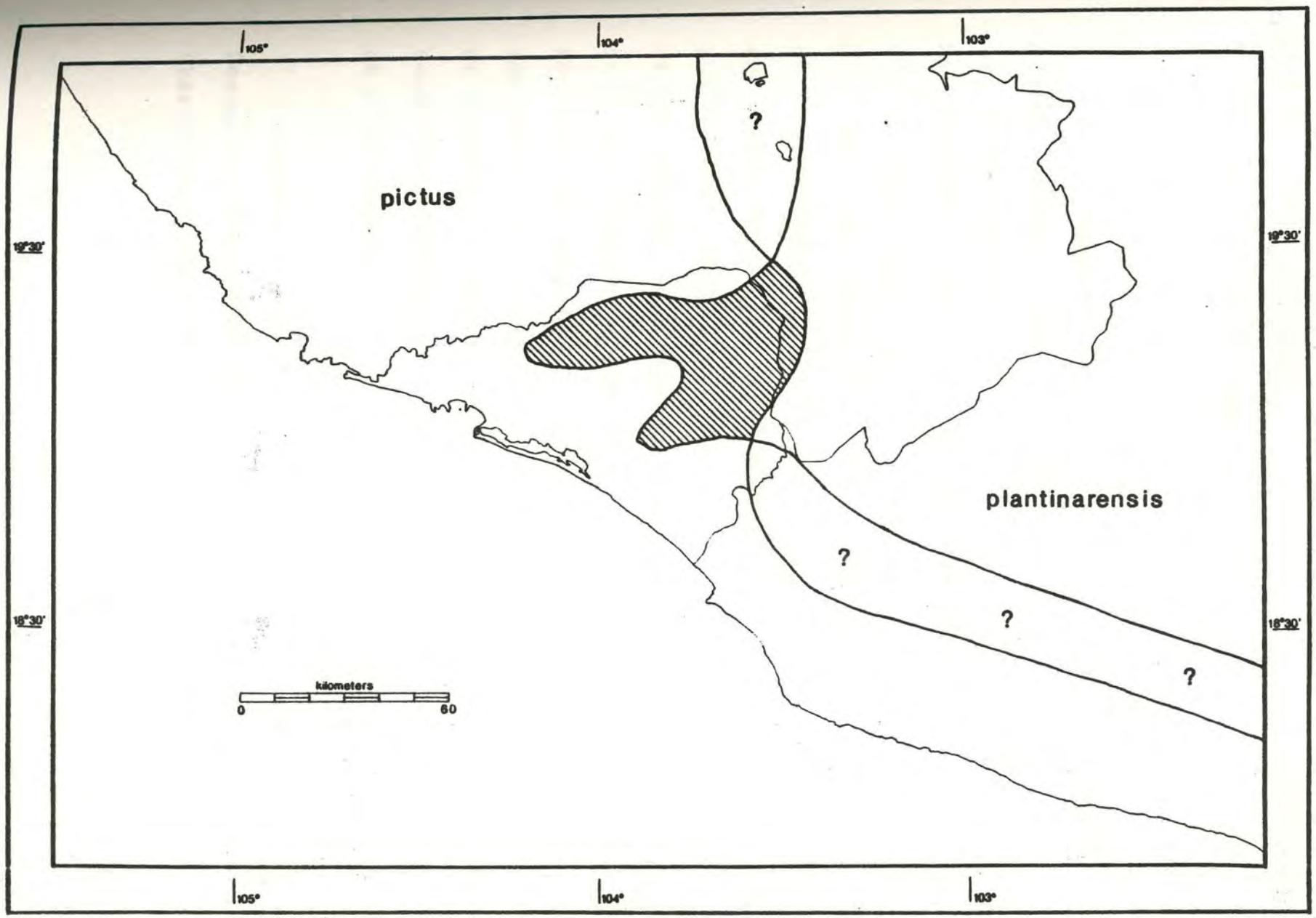
Morphological data alone cannot be used to definitely identify hybrids or the extent of hybridization (or introgression) in a contact zone. However, the data presented herein, generally are consistent with those expected of a narrow contact zone where only limited hybridization between otherwise distinct taxa ocurs, rather than clinal variation and broad intergradation between two contiguous morphotypes. Most individuals from the contact zone which were not initially assigned to a subspecies were distinct and definitely assignable to one

Fig. 6. Frequency histograms of discriminant scores for *Liomys pictus*. Dark bars correspond to *L. p. plantinarensis* and white bars to *L. p. pictus*. A: reference samples alone. B: all individuals (shaded areas correspond to outliers identified in the Nearest Neighbor Discriminant Analysis).


A
100
70
40
10
17
19
21
23
25
27
B
140
110
80
50
20
17
19
21
23
25
27

of the reference morphotypes. Only 18 % of the individuals were classified as outliers. L. p pictus and L. p. plantinarensis can easily be separated morphologically, even including young adults (age class III). Furthermore, the ranges of these taxa overlap over a large portion of the state of Colima, apparently with only limited introgression ocurring (Fig. 7).

Fig. 7. Distribution of L. p. pictus and L. p. plantinarensis in Colima and southern Jalisco, Mexico. Shaded area correspond to the zone of contact between the taxa. Question marks represent areas of potential contact between the taxa from which specimens are unavailable.


105°
104°
103°
19°30'
18°30'
pictus
plantinarensis
?
?
?
?
kilometers
0
60

DISCUSSION

In his analysis of nongeographic variation in Liomys pictus, Genoways (1973) concluded that there was significant sexual dimorphism in his sample. However, Straney (1978) using the same data set, found sex to explain only a minor portion of the total variation. In my study, only a relatively small component of variation (4.9%) was accounted for by secondary sexual variation and sexes were pooled in other analyses (see also Rogers and Schmidly, 1982; Engstrom et al., in press). Genoways (1973) included only two age classes in his geographic analysis, whereas in this study, four age classes were found to be homogeneous and were included. Pooling sexes, and additional age classes probably decreased resolution of differences between the reference samples, and separation observed between the subspecies in this study is conservative.

In general, my results confirmed those outlined by Genoways (1973) with regard to the morphological characterization of L. p. pictus and L. p.

plantinarensis. L. p. pictus averaged larger than L. p. plantinarensis for most cranial characters. Using any of at least six cranial characters (GLS, ZB, MB, LN, LR, and IL) reference specimens could usually be identified to subspecies and these differences generally were maintained in the zone of contact. Interparietal length (IL) in particular, consistently separated these taxa, despite greater variability of IL relative to other characters (see C.V.'s in appendix II). IL was usually greater than 4 mm in L. p. pictus, and less than 4 mm in L. p. plantinarensis. Length of hindfoot (LHF), although not used in the multivariate analyses, also consistently separated the two taxa. Individuals assigned to L. p. pictus usually had a LHF greater than 28 mm, whereas those assigned to L. p. plantinarensis had a LHF less than 28 mm. Mensural differences between the taxa for IL and LHF were, in most cases, maintained in age classes 1 and 2.

Qualitatively, posterior margin of interparietal (PMI) and brightness of the lateral line (LL) also were good indicators of subspecies, even within the contact zone. L. p. pictus usually had an unnotched PMI and a bright ochraceous lateral line, whereas in L. p. plantinarensis PMI more often than not was notched and the lateral line was pale or absent.

Multivariate analyses clearly summarized the size differences between these taxa. These overall differences are largely maintained within the zone of contact wherin size distribution remains bimodal. Neff and Smith (1979) and Cothran (1983) cautioned against the use of discriminate analysis for the identification of hybrid individuals, because the analysis requires that individuals to be identified belong to one of the reference groups. Therefore, in this study, discriminant analyses were used to characterize only the general pattern of morphological differentiation within the contact zone and not to definitively assign individuals to reference groups or identify hybrids.

Genoways (1973) regarded the area near Colima City, Colima as an intergradation zone between L. p. pictus and L. p. plantinarensis, mainly because the few specimens available from the area appeared to be morphological intermediates. In this study, I intensively sampled the area, especially the mountains west and south of Colima City and found a distinct bimodal distribution of specimens, including sympatric localities, with little evidence of broad intergradation. Although the ranges of the taxa overlap over much of the state of Colima and some hybridization probably occurs, in general, the taxa

maintain their morphological identity, and introgression appears to be minimal.

The geographic distributions of L. p. pictus and L. p. plantinarensis (Genoways, 1973), correspond closely to the distribution of Tropical Subdeciduous Forest and Tropical Deciduous Forest as defined by Rzedovski and McVaugh (1966). The most important factors that affect the distribution of these forests are temperature and humidity. Where Tropical Subdeciduous Forest and Tropical Deciduous Forest contact, there is a broad transition belt with a mosaic distribution, wherein the former occurs in dales and protected areas, and the later in slopes and exposed areas. These two vegetation types co-occur in the contact zone of L. p. pictus and L. p. plantinarensis. Specimens of L. pictus collected during this study within the contact zone, follow the same mosaic distributions. Individuals assigned to L. p. pictus typically occurred in Tropical Subdeciduous Forest in more protected and mesic areas, and those assigned to L. p. plantinarensis typically occurred on drier slopes in Tropical Deciduous Forest. Both taxa and some apparent intermediates were found in transitional areas. However, even within trap lines, where the two subspecies were taken together, L. p. pictus was most common in mesic

areas and L. p. plantinarensis was commonest in drier areas.

In this area of Mexico, three major mountain ranges intersect: the Sierra Madre Occidental, the Eje Neovolcanico Transversal, and the Sierra Madre del Sur. Populations of Liomys pictus pictus in the study area are distributed along the coast and Pacific slopes of the Sierra Madre Occidental, and then inland to northern Colima and southern Jalisco following the southern rim of this mountain range and Valley of the Rio Armeria. Populations of Liomys pictus plantinarensis are distributed along the internal slopes of the Sierra Madre del Sur through the Rio Balsas Basin, and on into southern Jalisco and northern Colima following the northern rim of the Sierra Madre del Sur, where they contact populations of L. p. pictus.

Although aware of the limitations of morphological data in resolving the nature and extent of intergradation in zones of contact, I hypothesize that genetic exchange between L. p. pictus and L. p. plantinarensis is limited. If this hypothesis is correct, these taxa fit the definition of semispecies (Mayr, 1969:411) "populations that have acquired some, but not yet all, attributes of species rank".

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APPENDIX I: Specimens examined.

MEXICO. Colima: 10 km NW Alzada, 2 (ASNHC); 5 km S Alzada, 3 (ASNHC); 3 km S Armeria, 1 (LSUMZ); 4 km SW Armeria, 2 (UA); 5 mi NNE Armeria, 6 (TCWC); Armeria, 9 (USNM); 2 mi NE Camotlan, 4 (LACM); Cerro chino, 3 (LACM); 4 mi S Chanchopa, 3 (OUM); 2 km NW Chiapa, 51 (ASNHC); 2 mi SE Cihuatlan, Jal., 1 (UA); 10 km SE Colima, 11 (ASNHC); 14.5 mi N Colima, 10 (LACM); 15 km SSW Colima, 13 (ASNHC); 17 km NW Colima, 8 (ASNHC); 22 km NW Colima, 10 (ASNHC); 22 km SSW Colima, 7 (ASNHC); 23 km SW Colima, 3 (CAS); 27 km SSW Colima, 5 (ASNHC); 29.5 km NW Colima, 11 (ASNHC); 3 km SE Colima, 12 (ASNHC); 3 mi NE Colima, 2 (LACM); 3 mi SE Colima, 1 (UMMZ); 31 km NW Colima, 1 (ASNHC); 33.5 km SSW Colima, 7 (ASNHC); 34 km NW Colima, 2 (ASNHC); 4 km SSW Colima, 2 (ASNHC); 4 mi NNE Colima, 1 (LACM); 4 mi SE Colima, 7 (LACM); 4 mi SW Colima, 1 (KU); 8 km NW Colima, 10 (ASNHC); 9 mi NNE Colima, 1 (LACM); Colima, 4 (USNM); 13 km NW Colima, 9 (ASNHC); 11 mi W Comala, 24 (LACM); 13 km NE Comala, 30 (UM); Comala, 1 (LACM); 1 km N Comatlan, 7 (UA); 6 km S Cuauhtemoc, 3 (ASNHC); 3 mi E Cuyutlan, 7 (MSUMZ); 5.6 mi NW Cuyutlan, 3 (MSUMZ); 6 km NE Cuyutlan, 2 (ASNHC); 7 km NE Cuyutlan, 3 (ASNHC); 8.4 mi NW Cuyutlan, 8 (MSUMZ); Cuyutlan, 1 (UI); El Charco, 9 (LACM); El Cobano, 116 (MSUMZ); 0.25 mi E El Cobano, 16 (MSUMZ); 0.5 mi E El Cobano, 8 (OUM); 0.5 mi W El Cobano, 23 (OUM); 0.7 mi NE El Cobano, 3 (MSUMZ); 0.8 mi E El Cobano, 1 (MSUMZ); 1 mi ESE El Cobano, 19 (OUM); 1 mi W El Cobano, 20 (OUM); 1.4 mi E El Cobano, 30 (MSUMZ); 10 km NE El Cobano, 4 (OUM); 2 mi NW El Cobano, 41 (MSUMZ); El Terrero, 7 (LACM); 3.5 km ESE Estancia, 13 (OUM); Hda. San Antonio, 8 (ASNHC); 1 km NE Hda. San Antonio, 4 (OUM); 2 km NE Hda. San Antonio, 10 (UM); 2.5 mi SE Hda. San Antonio, 6 (MSUMZ); Hda. San Antonio, 3 (USNM); 3 mi E Ixtlahuacan, 7 (LACM); 5 mi NE La Cofradia, 29 (LACM); 7 mi NE La Cofradia, 1 (LACM); La Cofradia, 15 (LACM); Las Lomas, 2 (UA); 12.5 mi SE Los Tepames, 2 (LACM); Hda. Magdalena, 6 (USNM); 18 km NNE Manzanillo, 9 (ASNHC); 2 km N Manzanillo, 1 (UI); 30 km NNE Manzanillo, 29 (ASNHC); 5 mi N Manzanillo, 2 (KU); 2.5 mi W Mexcala, 4 (TCWC); Minatitlan, 8 (LACM); 3 km SE Ortices, 12 (OUM); Paso del Rio, 18 (UMMZ); Playa de Oro, 15 (MSUMZ); 29 km W Pueblo Juarez, 4 (UA); 5 km SE Pueblo Juarez, 2 (UA); 6 km N Pueblo Juarez, 1 (LACM); Pueblo Juarez, 20 (LACM); 5.5 km W Queseria, 15 (ASNHC); 6.9 mi W Queseria, 8 (MSUMZ); 8.5 km W Queseria, 13 (ASNHC); 2.4 km S Rincon de Lopez, 3 (ASNHC); 4.7 km S Rincon de Lopez, 7 (ASNHC); 2 km NE San Marcos, 1 (UA); 18 km W Santiago, 6 (OUM); 3 km S Santiago, 1 (KU); 3 mi N Santiago, 3 (KU); 4 mi W, 1 mi S Santiago, 1 (KU); 6 km N Santiago, 1 (KU); 8 km NNE Tecoman, 5 (ASNHC); 3 km E Tecuizitan, 9 (ASNHC); 2 km N Tlapeixtes, 1 (UA); 4 mi E Trapichillos, 2 (OUM); Trapichillos, 2 (UA).

MEXICO. Jalisco: Arroyo de Platanar, 5 (AMNH); 6 km S Atenquique, 4 (LACM); 9.8 mi W Atenquique, 2 (OUM); 11 mi SW Autlan, 6 (KU); 2 mi SSE Autlan, 30 (KU); 2.5 mi NNE Autlan, 2 (KU); La Cumbre de Autlan, 4 (UA); 10 mi NW Barra de Navidad, 4 (UI); 8 mi NW Barra de Navidad, 18 (UI); 3 mi NW Barra de Navidad, 10 (KU); 5 km NNW Barra de Navidad, 1 (KU); 5 mi NE Barra de Navidad, 1 (KU); Bay of Chamela, 5 (UMMZ); Bay of Navidad, 1 (UMMZ); Bay of Tenacatita, 3 (UMMZ); 5 mi S Cd. Guzman, 1 (USNM); 0.5 mi S Chamela, 5 (UI); 12 mi N Chamela, 6 (UI); 24 mi NW Chamela, 2 (UI); 3 mi E Chamela, 8 (UI); 3 mi E Chamela, 3 (UI); 4 mi N Chamela, 10 (UI); 6 km E Chamela, 15 (MSU); 6 mi S, 0.5 mi E Chamela, 3 (UI); 8 km E Chamela, 52 (UNAM); Estacion de Biologia UNAM, Chamela, 6 (ASNHC); 15 km NW Cihuatlan, 6 (KU); 5 mi W Cihuatlan, 1 (TCWC); Cihuatlan, 1 (KU); 1.3 mi NE Contla, 1 (KU); 1.8 mi NE Contla, 4 (KU); 10 km NE Contla, 10 (ASNHC); 11 km NE Contla, 5 (ASNHC); 2.2 mi NE Contla, 6 (KU); 3 mi NE Contla, 12 (TCWC); 4 km NE Contla, 4 (ASNHC, KU); 9 mi NE Contla, 2 (KU); Cuitzmala, 14 (KU); 14 km S Durazno, 10 (KU);2 km NW Emiliano Zapata, 3 (KU); 6 mi E El Limon, 3 (KU); Estancia, 6 (AMNH); 8 mi E Jilotlan, 24 (KU); Jilotlan, 3 (KU); 2 mi SW La Resolana, 14 (KU); 12 mi NW Mascota, 1 (KU); 14 mi NW Mascota, 1 (KU); 3 mi N Mascota, 1 (KU); 5.5 mi N Melaque, 8 (TCWC); 6.5 mi N Melaque, 1 (TCWC); 7 mi NE Melaque, 1 (LACM); 9.5 mi NW Melaque, 29 (TCWC); 0.5 mi N Navidad, 3 (UMMZ); 3 MI E Navidad, 3 (UMMZ); 14.5 mi S Pihuamo, 8 (KU); 1 km N Platanar, 13 (ASNHC); 20 km WNW Purificacion, 10 (KU); 1 km SW San Mames, 3 (ASNHC); 2 km NE San Marcos, 17 (ASNHC); 5 km SW San Marcos, 12 (ASNHC); 10 mi NW San Patricio, 12 (MSUMZ); 30 km N, 10 km E Santiago (Col.), 1 (KU); Sebastian, 1 (USNM); 13 km SW Tamazula, 1 (KU); 4 km NE Tamazula, 16 (KU); 7 mi SE Tapalpa, 2 (KU); 8 km N Tecalitlan, 2 (KU); 5 mi SW Tecomate, 6 (KU); 7.5 mi SE Tecomate, 8 (KU); 2 mi N Tenacatita, 2 (KU); 4 km W Tuxpan, 2 (KU); 2.7 mi WNW Zapoltitic, 16 (KU); 3.5 mi WNW Zapoltitic, 2 (KU).

MEXICO. Michoacan: 16 mi S Arteaga, 4 (KU); 1 km N La Mira, 10 (ASNHC); 1 mi E La Mira, 1 (KU); 8 km N La Mira, 13 (ASNHC); Los Reyes, 2 (USNM); 4 km N, 3 km W Playa Azul, 7 (ASNHC); 4 km N, 13 km W Playa Azul, 1 (ASNHC); 7 mi S Tumbiscatio, 8 (KU).

APPENDIX 2. STANDARD STATISTICS FOR MORPHOLOGICAL CHARACTERS WITHIN GROUPED LOCALITIES OF Liomys pictus. AGES CLASSES III TO VI COMBINED. GROUPED LOCALITIES ARE DEFINED IN TEXT.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 1			
TL	8	231.62	7.53	222.00	241.00	3.25
LT	7	120.42	6.65	110.00	129.00	5.52
LHF	8	29.37	0.74	28.00	30.00	2.53
LE	8	15.87	0.83	15.00	17.00	5.25
GLS	8	31.26	0.79	29.45	32.05	2.53
ZB	8	14.48	0.48	13.85	15.20	3.37
POC	8	7.81	0.25	7.50	8.30	3.24
MB	8	14.18	0.37	13.45	14.65	2.60
LN	8	12.81	0.46	11.90	13.40	3.64
LPM	8	13.21	0.58	12.15	14.05	4.40
LR	8	13.35	0.49	12.15	13.65	3.71
IW	8	8.79	0.58	8.20	9.95	6.60
IL	8	4.56	0.38	4.00	5.25	8.45
LMT	8	4.96	0.16	4.75	5.25	3.35
TLT	8	14.32	0.40	13.70	14.85	2.84
BM	8	5.70	0.14	5.50	5.85	2.49
PPW	8	5.19	0.25	4.85	5.50	4.83
DBC	8	10.02	0.19	9.75	10.25	1.90

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 2			
TL	74	230.98	14.72	190.00	302.00	6.37
LT	74	118.82	8.39	80.00	135.00	6.99
LHF	83	27.84	1.74	24.00	31.00	6.25
LE	81	15.04	1.43	11.00	18.00	9.56
GLS	89	31.26	0.95	28.00	34.55	3.06
ZB	76	14.60	0.48	13.50	16.20	3.34
POC	92	7.77	0.36	6.85	8.55	4.67
MB	91	14.41	0.45	13.05	15.50	3.14
LN	91	12.99	0.73	11.00	15.00	5.64
LPM	91	13.58	0.73	11.70	16.15	5.44
LR	91	13.73	0.60	12.00	15.55	4.42
IW	89	8.76	0.47	7.80	9.90	5.39
IL	89	4.50	0.32	3.90	5.25	7.18
LMT	90	4.98	0.22	4.35	5.70	4.47
TLT	90	14.48	0.46	13.10	15.95	3.20
BM	89	5.82	0.24	5.00	6.35	4.11
PPW	93	5.20	0.21	4.50	5.70	4.07
DBC	88	10.01	0.27	9.30	10.60	2.79

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 3			
TL	23	228.43	14.09	204.00	256.00	6.16
LT	23	117.00	9.79	91.00	138.00	8.37
LHF	31	28.00	1.09	26.00	30.00	3.91
LE	31	14.58	0.80	13.00	16.00	5.53
GLS	29	31.23	1.01	28.50	33.45	3.26
ZB	31	14.51	0.48	13.20	15.40	3.36
POC	31	7.68	0.33	7.15	8.40	4.41
MB	31	14.21	0.32	13.55	14.75	2.25
LN	30	13.24	0.73	11.50	14.70	5.53
LPM	30	13.70	0.72	12.00	15.05	5.25
LR	30	13.73	0.61	12.15	14.85	4.45
IW	31	8.95	0.42	8.00	9.70	4.70
IL	31	4.55	0.35	4.10	5.45	7.70
LMT	31	5.02	0.17	4.65	5.40	3.53
TLT	31	14.47	0.50	13.40	15.35	3.45
BM	31	5.80	0.16	5.50	6.20	2.87
PPW	31	5.17	0.20	4.70	5.60	3.94
DBC	31	9.95	0.22	9.45	10.40	2.24

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 4			
TL	55	239.63	14.55	210.00	278.00	6.07
LT	55	123.23	9.98	96.00	144.00	8.09
LHF	63	29.19	1.56	26.00	37.00	5.35
LE	64	15.54	0.85	14.00	17.00	5.48
GLS	63	31.66	0.95	29.55	33.70	3.01
ZB	62	14.68	0.45	13.65	16.20	3.08
POC	64	7.88	0.35	7.00	8.90	4.50
MB	64	14.53	0.34	13.90	15.45	2.40
LN	63	13.31	0.61	11.75	14.45	4.65
LPM	63	13.83	0.59	12.50	15.10	4.29
LR	63	13.91	0.56	12.80	15.40	4.03
IW	62	8.85	0.49	7.80	9.85	5.59
IL	63	4.68	0.32	3.90	5.60	6.94
LMT	64	5.03	0.23	4.55	5.75	4.67
TLT	64	14.72	0.46	13.75	15.70	3.17
BM	63	5.89	0.22	5.30	6.50	3.87
PPW	64	5.22	0.19	4.85	5.60	3.77
DBC	64	10.10	0.25	9.60	10.60	2.54

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED	LOCALITY 5		
TL	13	236.69	7.48	223.00	249.00	3.16
LT	13	124.23	5.81	116.00	134.00	4.68
LHF	14	28.85	0.86	28.00	30.00	2.99
LE	14	15.50	0.94	14.00	17.00	6.06
GLS	14	31.81	0.73	30.00	32.75	2.32
ZB	14	14.82	0.41	14.15	15.50	2.77
POC	14	7.95	0.40	7.15	8.70	5.08
MB	14	14.66	0.34	14.05	15.30	2.38
LN	14	13.39	0.45	12.50	14.40	3.39
LPM	14	13.86	0.48	12.70	14.60	3.50
LR	14	13.93	0.37	12.95	14.50	2.70
IW	14	8.91	0.38	7.95	9.40	4.28
IL	14	4.48	0.25	4.05	4.85	5.58
LMT	14	4.97	0.13	4.75	5.20	2.78
TLT	14	14.74	0.32	14.40	15.40	2.23
BM	14	5.85	0.32	5.10	6.25	5.56
PPW	14	5.28	0.27	4.85	5.70	5.20
DBC	14	10.15	0.24	9.65	10.45	2.41

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED	LOCALITY 6		
TL	20	218.15	11.45	192.00	241.00	5.25
LT	20	111.50	9.40	91.00	136.00	8.43
LHF	21	27.85	1.15	26.00	30.00	4.13
LE	21	14.00	0.63	13.00	15.00	4.51
GLS	24	30.25	0.87	28.75	32.40	2.90
ZB	25	14.17	0.48	13.00	15.10	3.43
POC	26	7.51	0.20	6.95	7.95	2.74
MB	25	14.23	0.35	13.60	15.00	2.46
LN	26	12.75	0.58	11.95	14.40	4.62
LPM	26	13.31	0.54	12.35	14.75	4.06
LR	26	13.01	0.52	12.25	14.40	4.05
IW	26	8.81	0.43	7.50	9.50	4.95
IL	26	4.44	0.38	3.75	5.30	8.63
LMT	25	4.95	0.16	4.65	5.30	3.40
TLT	25	14.14	0.53	13.00	15.20	3.78
BM	25	5.68	0.17	5.20	6.00	3.02
PPW	26	4.99	0.14	4.80	5.25	2.98
DBC	25	9.81	0.26	9.10	10.30	2.70

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 7			
TL	16	237.50	14.58	212.00	264.00	6.14
LT	16	120.68	8.58	105.00	135.00	7.11
LHF	17	29.58	1.06	28.00	31.00	3.59
LE	16	15.75	0.85	14.00	17.00	5.43
GLS	17	31.86	1.09	29.85	33.95	3.45
ZB	17	14.70	0.50	13.85	15.60	3.46
POC	17	7.77	0.36	7.10	8.45	4.74
MB	17	14.53	0.39	14.00	15.45	2.74
LN	16	13.53	0.78	12.50	14.95	5.82
LPM	17	14.05	0.70	12.60	15.40	5.04
LR	17	14.05	0.72	12.80	15.50	5.14
IW	17	8.91	0.45	8.10	9.70	5.12
IL	17	4.60	0.31	4.15	5.20	6.90
LMT	17	5.12	0.17	4.75	5.50	3.38
TLT	17	14.72	0.45	13.50	15.35	3.10
BM	17	5.84	0.16	5.60	6.05	2.81
PPW	17	5.24	0.18	4.95	5.50	3.46
DBC	17	10.12	0.27	9.70	10.65	2.69

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 8			
TL	21	241.85	15.65	215.00	270.00	6.47
LT	22	122.09	9.43	109.00	140.00	7.72
LHF	21	29.00	1.76	23.00	32.00	6.07
LE	21	14.61	1.56	10.00	16.00	10.70
GLS	19	32.41	1.29	30.00	34.80	4.00
ZB	19	14.84	0.71	13.80	16.20	4.79
POC	21	7.71	0.30	7.05	8.25	3.97
MB	22	14.65	0.52	13.90	15.60	3.61
LN	18	13.75	0.89	12.35	15.45	6.49
LPM	18	14.21	0.91	12.80	15.80	6.43
LR	18	14.37	0.81	12.85	15.60	5.66
IW	22	9.02	0.43	8.45	9.99	4.77
IL	21	4.54	0.35	3.70	5.20	7.90
LMT	20	5.03	0.21	4.70	5.40	4.30
TLT	20	15.01	0.53	13.85	16.00	3.54
BM	20	5.93	0.36	5.15	6.90	6.18
PPW	22	5.26	0.19	4.80	5.70	3.71
DBC	19	10.09	0.31	9.55	10.70	3.11

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 9			
TL	3	237.33	28.02	206.00	260.00	11.80
LT	3	121.66	16.44	103.00	134.00	13.51
LHF	3	27.33	1.15	26.00	28.00	4.22
LE	3	15.00	0.00	15.00	15.00	0.00
GLS	3	30.95	2.10	28.55	32.50	6.81
ZB	3	15.08	0.96	14.45	16.20	6.43
POC	3	7.81	0.07	7.75	7.90	0.97
MB	3	14.30	0.55	13.75	14.85	3.83
LN	3	12.95	0.92	12.00	13.85	7.15
LPM	3	13.48	1.02	12.40	14.45	7.63
LR	3	13.41	1.18	12.05	14.20	8.85
IW	3	9.08	0.18	8.95	9.30	2.08
IL	3	4.20	0.32	3.85	4.50	7.80
LMT	3	5.03	0.30	4.65	5.35	5.98
TLT	3	14.31	0.96	13.20	14.90	6.75
BM	3	5.58	0.15	5.45	5.75	2.73
PPW	3	4.81	0.30	4.50	5.10	6.25
DBC	3	9.86	0.28	9.70	10.20	2.92

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 10			
TL	8	231.25	10.06	218.00	250.00	4.35
LT	8	118.75	6.81	108.00	130.00	5.74
LHF	9	28.22	0.83	27.00	29.00	2.95
LE	9	14.55	0.52	14.00	15.00	3.62
GLS	9	31.73	0.96	30.20	33.40	3.03
ZB	8	15.04	0.30	14.55	15.40	2.02
POC	9	7.57	0.36	6.95	8.00	4.77
MB	9	14.48	0.35	14.00	15.10	2.47
LN	9	13.40	0.80	12.10	14.55	6.01
LPM	9	13.94	0.69	12.70	14.65	4.98
LR	9	13.93	0.63	12.60	14.85	4.53
IW	9	8.66	0.45	8.00	9.40	5.28
IL	9	4.31	0.45	3.55	4.90	10.55
LMT	9	5.04	0.19	4.70	5.40	3.85
TLT	9	14.90	0.42	14.20	15.75	2.83
BM	9	5.99	0.26	5.60	6.45	4.46
PPW	9	5.24	0.60	4.95	5.45	3.10
DBC	9	10.01	0.13	9.85	10.25	1.36

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 11			
TL	9	233.44	5.79	225.00	242.00	2.48
LT	9	121.11	7.04	108.00	133.00	5.81
LHF	9	28.88	1.53	26.00	31.00	5.31
LE	9	14.33	0.70	13.00	15.00	4.93
GLS	7	32.26	0.84	30.90	33.00	2.61
ZB	9	14.97	0.25	14.55	15.45	1.69
POC	9	7.67	0.21	7.35	8.00	2.74
MB	8	14.75	0.51	14.30	15.90	3.50
LN	9	13.75	0.59	12.90	14.80	4.35
LPM	9	14.11	0.61	13.35	14.95	4.37
LR	9	14.15	0.48	13.30	14.80	3.42
IW	8	9.10	0.43	8.40	9.50	4.74
IL	8	4.76	0.38	4.25	5.45	8.14
LMT	8	5.05	0.12	4.90	5.30	2.42
TLT	8	14.83	0.31	14.30	15.30	2.14
BM	7	5.82	0.25	5.35	6.15	4.45
PPW	9	5.17	0.23	4.85	5.55	4.48
DBC	8	10.10	0.17	9.85	10.40	1.73

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 12			
TL	2	224.50	20.50	210.00	239.00	9.13
LT	2	116.00	9.89	109.00	123.00	8.53
LHF	2	27.00	1.41	26.00	28.00	5.23
LE	2	14.00	0.00	14.00	14.00	0.00
GLS	1	30.50		30.50	30.50	
ZB	2	14.07	0.60	13.65	14.50	4.27
POC	2	7.57	0.45	7.25	7.90	6.06
MB	2	14.00	0.91	13.35	14.65	6.56
LN	1	12.90		12.90	12.90	
LPM	1	13.05		13.05	13.05	
LR	1	13.45		13.45	13.45	
IW	2	9.05	1.06	8.30	9.80	11.72
IL	2	4.67	0.67	4.20	5.15	14.36
LMT	2	4.97	0.03	4.95	5.00	0.71
TLT	2	14.30	0.49	13.95	14.65	3.46
BM	2	5.75	0.28	5.55	5.95	4.91
PPW	2	4.90	0.28	4.70	5.10	5.77
DBC	2	9.80	0.28	9.60	10.00	2.88

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 13			
TL	9	230.55	13.55	205.00	250.00	5.88
LT	9	120.88	6.91	111.00	129.00	5.72
LHF	9	28.66	0.86	27.00	30.00	3.02
LE	9	15.44	0.88	14.00	17.00	5.71
GLS	9	31.36	0.81	30.40	32.70	2.60
ZB	9	14.53	0.51	14.10	15.50	3.52
POC	9	7.66	0.29	7.30	8.10	3.78
MB	9	14.36	0.47	13.50	14.95	3.27
LN	9	13.30	0.54	12.60	14.35	4.08
LPM	9	13.75	0.48	13.20	14.75	3.50
LR	9	13.82	0.63	13.20	15.00	4.62
IW	9	9.16	0.55	8.20	9.99	6.03
IL	9	4.52	0.33	4.05	5.10	7.44
LMT	9	4.96	0.17	4.65	5.15	3.48
TLT	9	14.42	0.53	13.75	15.25	3.74
BM	9	5.83	0.23	5.40	6.15	4.02
PPW	9	5.24	0.20	4.95	5.55	3.85
DBC	9	9.92	0.32	9.35	10.35	3.23

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 14			
TL	6	239.50	12.77	217.00	253.00	5.33
LT	6	120.50	9.54	103.00	131.00	7.92
LHF	6	28.83	1.72	26.00	31.00	5.97
LE	6	14.83	0.75	14.00	16.00	5.07
GLS	6	32.35	0.87	31.20	33.25	2.71
ZB	6	15.02	0.49	14.40	15.80	3.27
POC	6	7.70	0.36	7.30	8.20	4.68
MB	6	14.54	0.45	14.00	15.25	3.14
LN	6	13.74	0.45	13.20	14.25	3.33
LPM	6	14.21	0.32	13.90	14.65	2.27
LR	6	14.30	0.56	13.65	15.10	3.92
IW	6	8.83	0.39	8.25	9.15	4.50
IL	6	4.59	0.17	4.40	4.90	3.79
LMT	6	5.08	0.13	4.90	5.25	2.61
TLT	6	15.15	0.27	14.90	15.40	1.80
BM	6	5.87	0.13	5.65	6.00	2.26
PPW	6	5.17	0.15	4.95	5.35	2.91
DBC	6	10.17	0.25	9.90	10.60	2.48

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 15			
TL	20	230.00	22.44	195.00	266.00	9.75
LT	20	117.85	16.09	90.00	144.00	13.65
LHF	26	27.5	2.54	23.00	32.00	9.27
LE	26	15.26	1.34	13.00	17.00	8.79
GLS	26	30.96	1.80	28.00	34.15	5.82
ZB	26	14.46	0.92	12.85	16.15	6.41
POC	26	7.66	0.36	7.20	8.50	4.80
MB	26	14.12	0.46	13.15	14.80	3.28
LN	26	12.98	1.11	11.45	15.10	8.55
LPM	26	13.55	0.93	12.20	15.40	6.86
LR	26	13.58	1.07	11.95	15.70	7.88
IW	26	8.97	0.57	8.10	9.99	6.41
IL	26	4.33	0.67	3.15	5.40	15.69
LMT	26	4.96	0.18	4.60	5.30	3.70
TLT	26	14.43	0.82	13.05	16.00	5.70
BM	26	5.85	0.24	5.45	6.35	4.10
PPW	26	5.18	0.28	4.65	5.70	5.41
DBC	26	9.90	0.35	9.30	10.50	3.53

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 16			
TL	4	235.00	8.12	229.00	247.00	3.45
LT	4	118.00	5.94	113.00	126.00	5.03
LHF	4	29.50	1.29	28.00	31.00	4.37
LE	4	15.50	0.57	15.00	16.00	3.72
GLS	3	32.68	0.75	32.25	33.55	2.29
ZB	4	15.87	0.53	15.30	16.55	3.35
POC	4	7.88	0.67	7.20	8.70	8.51
MB	3	15.16	0.20	15.00	15.40	1.37
LN	4	13.78	0.74	12.90	14.70	5.43
LPM	4	14.38	0.35	13.95	14.80	2.48
LR	4	14.50	0.16	14.30	14.70	1.16
IW	3	9.36	0.11	9.30	9.50	1.23
IL	3	4.55	0.25	4.25	4.70	5.71
LMT	3	4.95	0.21	4.80	5.20	4.40
TLT	4	15.18	0.45	14.70	15.80	3.02
BM	3	5.95	0.08	5.85	6.00	1.45
PPW	4	5.37	0.20	5.10	5.55	3.75
DBC	3	10.36	0.27	10.10	10.65	2.65

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 17			
TL	3	230.00	28.47	205.00	261.00	12.38
LT	3	120.00	18.02	105.00	140.00	15.02
LHF	3	26.33	2.51	24.00	29.00	9.55
LE	3	14.33	1.52	13.00	16.00	10.65
GLS	3	30.16	2.34	28.50	32.85	7.77
ZB	3	13.68	1.03	12.75	14.80	7.58
POC	3	7.28	0.10	7.20	7.40	1.42
MB	3	13.65	0.44	13.30	14.15	3.25
LN	3	12.11	1.50	11.15	13.85	12.41
LPM	3	13.23	1.50	12.15	14.95	11.36
LR	3	13.10	1.34	12.00	14.60	10.27
IW	3	8.43	0.14	8.35	8.60	1.71
IL	3	4.08	0.35	3.70	4.40	8.68
LMT	3	4.93	0.36	4.70	5.35	7.33
TLT	3	14.16	1.59	13.15	16.00	11.23
BM	3	5.90	0.34	5.70	6.30	5.87
PPW	3	4.93	0.32	4.70	5.30	6.51
DBC	3	9.68	0.40	9.40	10.15	4.20

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 18			
TL	9	243.33	10.61	231.00	265.00	4.36
LT	9	128.22	6.55	118.00	136.00	5.11
LHF	11	29.09	1.13	27.00	31.00	3.90
LE	11	15.45	0.52	15.00	16.00	3.37
GLS	11	32.14	0.85	30.90	33.90	2.67
ZB	11	14.64	0.44	13.80	15.30	3.05
POC	11	7.83	0.45	7.25	8.65	5.79
MB	11	14.01	0.32	13.60	14.65	2.34
LN	11	13.15	0.70	12.35	14.80	5.35
LPM	11	14.00	0.44	13.30	14.75	3.15
LR	11	13.96	0.44	13.30	15.00	3.18
IW	11	9.06	0.37	8.40	9.70	4.17
IL	11	4.76	0.33	4.20	5.50	6.96
LMT	10	5.11	0.13	4.85	5.30	2.72
TLT	10	14.86	0.41	14.40	15.70	2.78
BM	10	5.93	0.16	5.75	6.20	2.81
PPW	11	5.15	0.23	4.85	5.50	4.64
DBC	11	10.06	0.33	9.55	10.60	3.34

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 19			
TL	20	230.60	9.73	203.00	247.00	4.21
LT	20	119.20	7.25	102.00	130.00	6.09
LHF	19	28.15	1.38	25.00	30.00	4.91
LE	20	15.30	1.21	13.00	19.00	7.96
GLS	18	31.89	1.14	28.90	33.00	3.59
ZB	18	14.76	0.65	13.15	15.50	4.42
POC	20	7.68	0.40	6.90	8.40	5.24
MB	20	14.29	0.44	13.55	15.35	3.10
LN	19	13.19	0.70	11.65	14.60	5.34
LPM	19	13.90	0.72	12.30	15.20	5.18
LR	19	14.02	0.68	12.45	15.00	4.89
IW	19	8.85	0.50	7.45	9.70	5.69
IL	19	4.47	0.30	3.65	4.90	6.74
LMT	20	5.14	0.23	4.65	5.45	4.47
TLT	20	14.96	0.58	13.35	15.70	3.92
BM	20	6.07	0.26	5.55	6.50	4.36
PPW	20	5.26	0.27	4.80	5.95	5.24
DBC	20	9.97	0.28	9.15	10.35	2.81

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 20			
TL	9	240.22	18.97	210.00	266.00	7.89
LT	9	127.88	13.17	111.00	147.00	10.30
LHF	9	27.66	2.29	24.00	30.00	8.28
LE	9	14.88	1.05	13.00	16.00	7.08
GLS	9	31.25	1.85	28.75	34.05	5.93
ZB	9	14.45	0.88	13.30	15.70	6.11
POC	9	7.68	0.35	7.15	8.25	4.55
MB	9	14.19	0.53	13.50	14.90	3.74
LN	9	12.78	1.15	11.50	15.25	9.03
LPM	9	13.72	1.16	12.20	15.95	8.49
LR	9	13.56	1.05	12.30	15.25	7.77
IW	9	8.74	0.45	8.00	9.20	5.24
IL	9	4.17	0.62	3.00	4.80	14.85
LMT	9	5.00	0.14	4.70	5.20	2.80
TLT	9	14.51	0.71	13.50	15.45	4.95
BM	9	5.82	0.16	5.60	6.05	2.84
PPW	9	5.04	0.19	4.75	5.30	3.78
DBC	9	9.78	0.34	9.20	10.15	3.57

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 21			
TL	35	238.34	15.49	202.00	264.00	6.50
LT	35	121.00	10.42	93.00	140.00	8.61
LHF	42	28.52	1.41	24.00	32.00	4.97
LE	40	14.67	0.85	13.00	16.00	5.85
GLS	37	31.72	1.05	29.25	33.65	3.32
ZB	36	14.64	0.66	13.40	16.60	4.53
POC	42	7.74	0.36	6.95	8.60	4.69
MB	40	14.23	0.46	13.50	15.40	3.30
LN	40	13.06	0.78	11.20	15.05	5.99
LPM	40	14.02	0.73	12.50	15.60	5.20
LR	39	14.07	0.62	12.70	15.15	4.42
IW	40	8.31	0.54	7.05	9.35	6.55
IL	40	4.39	0.34	3.75	5.20	7.83
LMT	41	5.03	0.21	4.55	5.50	4.19
TLT	41	14.80	0.47	13.75	15.55	3.18
BM	39	5.93	0.30	5.25	6.55	5.10
PPW	42	5.22	0.20	4.80	5.65	3.95
DBC	40	9.91	0.25	9.40	10.45	2.56

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 22			
TL	13	232.00	8.91	210.00	242.00	3.84
LT	13	120.00	8.80	101.00	133.00	7.33
LHF	14	28.14	1.09	26.00	29.00	3.90
LE	14	14.78	0.42	14.00	15.00	2.88
GLS	14	31.40	0.57	30.35	32.35	1.84
ZB	13	14.24	0.36	13.30	14.80	2.56
POC	14	7.48	0.22	7.00	8.00	3.03
MB	14	14.02	0.41	13.40	14.95	2.95
LN	14	12.99	0.60	12.00	14.10	4.67
LPM	14	13.94	0.46	13.10	14.55	3.31
LR	14	13.82	0.37	13.20	14.50	2.69
IW	14	8.92	0.46	8.00	9.70	5.17
IL	14	4.68	0.43	4.00	5.50	9.22
LMT	11	5.02	0.29	4.50	5.50	5.81
TLT	11	14.59	0.28	14.00	15.00	1.97
BM	10	5.87	0.28	5.40	6.25	4.90
PPW	14	5.14	0.28	4.30	5.45	5.63
DBC	14	9.59	0.24	9.15	9.95	2.57

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 23			
TL	6	214.00	10.17	202.00	230.00	4.75
LT	6	110.50	5.61	103.00	120.00	5.07
LHF	8	25.25	1.16	24.00	28.00	4.61
LE	8	14.00	0.92	13.00	16.00	6.61
GLS	8	29.27	0.95	28.15	30.90	3.25
ZB	8	13.18	0.52	12.55	14.05	4.00
POC	8	7.41	0.35	7.00	8.00	4.84
MB	8	13.57	0.34	13.20	14.05	2.51
LN	8	11.91	0.61	11.30	13.10	5.19
LPM	8	12.75	0.57	12.20	13.80	4.49
LR	8	12.55	0.51	11.95	13.50	4.06
IW	8	8.73	0.33	8.15	9.20	3.86
IL	8	3.58	0.37	3.20	4.25	10.42
LMT	8	4.78	0.21	4.50	5.25	4.42
TLT	8	13.73	0.49	13.15	14.55	3.58
BM	8	5.75	0.19	5.55	6.05	3.35
PPW	8	5.02	0.23	4.70	5.40	4.63
DBC	8	9.55	0.24	9.20	10.00	2.61

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 24			
TL	8	215.50	23.48	188.00	250.00	10.90
LT	8	109.62	15.96	89.00	135.00	14.56
LHF	8	25.00	2.32	22.00	28.00	9.32
LE	8	13.62	1.59	12.00	16.00	11.72
GLS	8	28.98	1.80	26.45	31.35	6.21
ZB	8	13.40	0.77	12.55	14.60	5.75
POC	8	7.22	0.27	7.00	7.80	3.77
MB	8	13.29	0.48	12.60	14.15	3.63
LN	8	11.94	0.90	10.55	13.10	7.58
LPM	8	12.73	1.01	11.15	14.20	7.98
LR	8	12.53	0.97	11.35	13.90	7.80
IW	8	8.57	0.55	7.80	9.70	6.50
IL	8	3.93	0.42	3.55	4.75	10.72
LMT	8	4.69	0.19	4.45	5.05	4.24
TLT	7	13.65	0.84	12.40	14.70	6.20
BM	8	5.62	0.22	5.40	6.15	4.08
PPW	8	4.85	0.29	4.55	5.45	5.98
DBC	8	9.38	0.31	9.05	10.05	3.36

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 25			
TL	24	235.00	16.43	212.00	270.00	6.99
LT	24	121.70	10.55	110.00	152.00	8.67
LHF	26	27.61	1.89	24.00	31.00	6.87
LE	20	15.35	0.87	14.00	17.00	5.70
GLS	22	31.45	1.06	29.20	33.50	3.37
ZB	24	14.42	0.61	13.35	15.30	4.27
POC	25	7.50	0.40	6.65	8.15	5.41
MB	26	14.31	0.44	13.05	14.90	3.08
LN	23	13.15	0.50	11.65	14.00	3.86
LPM	23	13.70	0.64	12.45	15.30	4.69
LR	23	13.81	0.58	12.60	14.80	4.21
IW	26	8.87	0.49	8.15	9.75	5.60
IL	25	4.60	0.30	4.05	5.25	6.66
LMT	26	4.93	0.19	4.55	5.35	3.92
TLT	26	14.63	0.49	13.80	15.55	3.37
BM	26	5.86	0.23	5.50	6.45	4.01
PPW	26	5.16	0.13	4.90	5.40	2.70
DBC	25	9.83	0.32	9.05	10.35	3.33

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 26			
TL	11	213.54	17.69	186.00	245.00	8.28
LT	11	103.72	10.79	89.00	118.00	10.41
LHF	11	26.81	1.16	25.00	29.00	4.35
LE	10	14.30	2.40	11.00	18.00	16.82
GLS	9	30.03	1.41	27.15	32.00	4.70
ZB	11	14.42	0.60	13.20	15.55	4.19
POC	11	7.28	0.34	6.90	8.00	4.72
MB	11	13.98	0.38	13.30	14.65	2.71
LN	9	12.43	0.73	10.70	13.25	5.94
LPM	9	12.79	0.71	11.50	13.80	5.61
LR	9	13.03	0.84	11.45	14.35	6.49
IW	11	8.83	0.57	7.70	9.75	6.53
IL	11	4.85	0.19	4.60	5.30	4.03
LMT	11	4.73	0.19	4.50	5.10	4.07
TLT	10	14.05	0.48	13.55	15.00	3.47
BM	11	5.64	0.23	5.10	5.90	4.09
PPW	11	5.06	0.16	4.75	5.30	3.33
DBC	11	9.73	0.18	9.45	10.10	1.94

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 27			
TL	13	193.84	8.96	177.00	205.00	4.62
LT	13	92.23	5.23	81.00	100.00	5.67
LHF	19	25.31	1.20	23.00	29.00	4.75
LE	19	12.89	0.80	11.00	14.00	6.27
GLS	17	28.02	1.99	20.80	30.00	7.13
ZB	18	13.16	0.34	12.60	13.60	2.58
POC	18	6.88	0.23	6.45	7.30	3.40
MB	19	13.28	0.34	12.65	13.90	2.63
LN	17	11.38	0.49	10.45	12.55	4.34
LPM	17	12.40	0.48	11.70	13.55	3.93
LR	17	11.94	0.48	11.15	13.10	4.06
IW	19	8.33	0.53	7.40	9.70	6.40
IL	19	3.33	0.27	2.90	3.90	8.17
LMT	18	4.90	0.14	4.65	5.20	2.98
TLT	18	13.32	0.38	12.65	14.25	2.87
BM	18	5.71	0.15	5.45	6.05	2.67
PPW	19	5.10	0.15	4.90	5.50	3.04
DBC	19	9.63	0.23	9.00	10.00	2.46

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 28			
TL	2	228.00	11.31	220.00	236.00	4.96
LT	2	113.50	0.70	113.00	114.00	0.62
LHF	2	28.50	0.70	28.00	29.00	2.48
LE	2	14.00	0.00	14.00	14.00	0.00
GLS	2	30.47	0.88	29.85	31.10	2.90
ZB	2	14.32	0.45	14.00	14.65	3.20
POC	2	7.87	0.10	7.80	7.95	1.34
MB	2	13.75	0.28	13.55	13.95	2.05
LN	2	12.32	0.03	12.30	12.35	0.28
LPM	2	13.10	0.63	12.65	13.55	4.85
LR	2	13.45	0.35	13.20	13.70	2.62
IW	2	8.25	0.07	8.20	8.30	0.85
IL	2	4.90	0.07	4.85	4.95	1.44
LMT	2	4.92	0.03	4.90	4.95	0.71
TLT	2	14.17	0.03	14.15	14.20	0.24
BM	2	5.95	0.21	5.80	6.10	3.56
PPW	2	4.92	0.17	4.80	5.05	3.58
DBC	2	9.95	0.21	9.80	10.10	2.13

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 29			
TL	28	237.25	12.36	212.00	265.00	5.21
LT	28	124.82	9.19	104.00	142.00	7.36
LHF	31	28.41	1.05	27.00	30.00	3.72
LE	31	14.80	0.60	13.00	16.00	4.06
GLS	31	31.31	0.70	30.05	32.75	2.26
ZB	32	14.12	0.45	13.40	14.90	3.25
POC	32	7.64	0.31	7.10	8.55	4.05
MB	32	13.76	0.37	13.15	14.50	2.75
LN	31	12.71	0.54	11.40	13.50	4.30
LPM	31	13.69	0.51	12.50	15.00	3.78
LR	31	13.78	0.37	13.20	14.90	2.70
IW	32	8.88	0.45	8.10	9.75	5.11
IL	32	4.59	0.42	3.85	5.55	9.20
LMT	32	5.01	0.18	4.75	5.50	3.66
TLT	32	14.54	0.35	13.85	15.45	2.44
BM	30	5.92	0.25	5.50	6.55	4.26
PPW	32	5.20	0.18	4.85	5.55	3.56
DBC	32	9.82	0.25	9.40	10.50	2.63

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 30			
TL	8	235.87	13.86	209.00	249.00	5.87
LT	8	115.37	7.30	100.00	124.00	6.33
LHF	10	29.30	2.21	25.00	32.00	7.55
LE	10	14.90	1.37	14.00	18.00	9.19
GLS	10	31.20	1.11	29.35	32.50	3.57
ZB	10	14.38	0.67	13.35	15.30	4.66
POC	10	7.40	0.30	7.00	7.90	4.09
MB	10	14.10	0.36	13.50	14.50	2.61
LN	10	12.88	0.74	11.30	13.75	5.75
LPM	10	13.76	0.61	12.70	14.65	4.44
LR	10	13.78	0.68	12.60	14.55	4.96
IW	10	8.37	0.47	7.75	9.30	5.73
IL	10	4.34	0.42	3.65	5.20	9.84
LMT	10	5.03	0.13	4.80	5.20	2.70
TLT	10	14.62	0.56	13.85	15.40	3.86
BM	10	6.09	0.20	5.80	6.35	3.29
PPW	10	5.23	0.19	5.00	5.60	3.80
DBC	10	9.85	0.21	9.55	10.15	2.14

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 31			
TL	10	202.90	19.36	186.00	250.00	9.54
LT	10	102.90	11.32	92.00	131.00	11.00
LHF	11	24.81	1.94	23.00	29.00	7.81
LE	11	13.09	0.94	12.00	15.00	7.21
GLS	11	28.37	1.54	26.90	31.25	5.42
ZB	11	12.94	1.10	11.55	15.00	8.55
POC	11	7.20	0.40	6.75	8.00	5.62
MB	11	13.35	0.65	12.60	14.65	4.88
LN	11	11.38	0.67	10.35	12.45	5.96
LPM	11	12.32	0.89	11.40	13.95	7.28
LR	11	12.10	0.90	11.25	13.80	7.50
IW	11	8.60	0.23	8.25	9.05	2.70
IL	11	3.65	0.49	3.15	4.75	13.49
LMT	11	4.53	0.18	4.25	4.85	4.09
TLT	11	13.24	0.79	12.30	14.90	6.03
BM	11	5.50	0.27	5.10	6.00	5.03
PPW	11	4.77	0.24	4.55	5.35	5.02
DBC	11	9.27	0.37	8.80	9.85	4.02

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 32			
TL	15	237.53	18.43	208.00	264.00	7.76
LT	15	125.00	11.42	107.00	144.00	9.14
LHF	17	28.41	1.00	27.00	30.00	3.53
LE	17	14.88	0.69	14.00	16.00	4.68
GLS	17	31.02	1.45	27.90	33.50	4.70
ZB	17	14.37	0.74	12.85	15.20	5.19
POC	17	7.56	0.38	7.10	8.40	5.08
MB	17	14.00	0.52	13.10	14.65	3.74
LN	17	12.83	1.03	11.00	14.60	8.07
LPM	17	13.41	1.08	11.30	15.15	8.07
LR	17	13.46	0.85	11.95	14.60	6.37
IW	17	8.93	0.55	7.90	9.85	6.22
IL	17	4.59	0.35	4.10	5.15	7.83
LMT	17	4.84	0.19	4.55	5.25	4.04
TLT	17	14.24	0.68	12.85	15.15	4.83
BM	17	5.68	0.14	5.50	6.00	2.54
PPW	17	5.14	0.19	4.75	5.50	3.82
DBC	17	9.84	0.28	9.45	10.45	2.85

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 33			
TL	25	223.44	16.10	190.00	253.00	7.20
LT	26	114.30	10.23	96.00	137.00	8.95
LHF	26	27.73	1.66	24.00	30.00	5.99
LE	19	14.42	1.30	12.00	17.00	9.04
GLS	27	30.03	1.45	27.45	32.50	4.84
ZB	33	14.16	0.72	12.65	15.50	5.14
POC	39	7.40	0.37	6.60	8.15	5.05
MB	36	14.06	0.42	13.40	14.75	3.00
LN	31	12.18	0.90	10.40	13.50	7.40
LPM	31	12.84	0.98	10.80	14.40	7.70
LR	31	12.94	0.79	11.30	14.25	6.13
IW	36	8.78	0.54	7.65	9.80	6.14
IL	37	4.58	0.30	3.85	5.40	6.62
LMT	39	4.77	0.22	4.20	5.15	4.69
TLT	39	13.93	0.56	12.50	15.00	4.02
BM	39	5.77	0.23	5.00	6.50	4.09
PPW	39	5.16	0.19	4.80	5.50	3.70
DBC	38	9.77	0.31	9.15	10.45	3.25

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 34			
TL	31	217.67	9.56	202.00	234.00	4.39
LT	31	108.70	7.67	94.00	120.00	7.05
LHF	32	26.06	0.71	25.00	27.00	2.74
LE	32	13.71	0.68	12.00	15.00	4.98
GLS	32	29.95	1.03	26.00	31.90	3.45
ZB	31	13.99	0.52	12.75	14.95	3.73
POC	32	7.26	0.19	6.90	7.85	2.64
MB	32	13.56	0.26	12.90	14.15	1.98
LN	32	12.41	0.45	11.75	13.50	3.69
LPM	32	13.38	0.42	12.50	14.20	3.17
LR	32	13.07	0.45	11.90	13.90	3.44
IW	32	8.61	0.31	7.95	9.10	3.66
IL	32	3.30	0.28	2.80	4.00	8.77
LMT	32	4.98	0.15	4.65	5.30	3.06
TLT	32	14.01	0.38	13.05	14.70	2.73
BM	31	5.77	0.17	5.35	6.10	2.94
PPW	32	5.12	0.11	4.85	5.35	2.18
DBC	32	9.76	0.27	9.35	10.65	2.77

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	- MAX	C.V.
			GROUPED LOCALITY 35			
TL	16	206.56	13.43	189.00	238.00	6.50
LT	16	102.56	9.14	90.00	125.00	8.91
LHF	18	25.72	0.82	24.00	27.00	3.21
LE	17	13.29	0.58	12.00	14.00	4.42
GLS	17	29.47	0.96	27.80	31.70	3.28
ZB	17	13.52	0.42	12.90	14.55	3.13
POC	17	7.25	0.23	6.90	7.70	3.23
MB	18	13.46	0.25	13.10	14.00	1.88
LN	17	11.96	0.58	11.10	13.15	4.93
LPM	17	12.87	0.61	12.00	14.20	4.76
LR	17	12.69	0.57	11.95	14.00	4.52
IW	18	8.66	0.32	8.05	9.25	3.74
IL	18	3.34	0.27	2.90	3.85	8.23
LMT	17	5.05	0.14	4.80	5.35	2.86
TLT	16	13.89	0.42	13.35	14.90	3.05
BM	16	5.82	0.11	5.60	6.00	2.05
PPW	18	5.08	0.19	4.75	5.50	3.90
DBC	18	9.62	0.23	9.25	10.05	2.39

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 36			
TL	4	212.75	11.89	195.00	220.00	5.59
LT	4	104.25	6.29	95.00	109.00	6.03
LHF	5	25.60	0.89	25.00	27.00	3.49
LE	5	13.20	0.44	13.00	14.00	3.38
GLS	4	29.55	0.76	28.60	30.40	2.58
ZB	4	13.71	0.55	13.10	14.45	4.05
POC	5	7.23	0.25	6.85	7.50	3.47
MB	5	13.37	0.29	12.90	13.65	2.23
LN	4	12.22	0.81	11.35	13.20	6.68
LPM	4	13.03	0.53	12.50	13.50	4.12
LR	4	12.81	0.44	12.45	13.45	3.51
IW	5	8.37	0.48	7.95	9.15	5.77
IL	5	3.18	0.18	3.00	3.45	5.94
LMT	5	4.98	0.16	4.75	5.20	3.22
TLT	4	13.82	0.45	13.20	14.30	3.30
BM	5	5.71	0.27	5.30	6.05	4.89
PPW	5	5.06	0.16	4.80	5.20	3.30
DBC	5	9.53	0.22	9.20	9.75	2.36

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 37			
TL	15	199.86	9.74	180.00	216.00	4.87
LT	15	102.20	6.22	92.00	115.00	6.09
LHF	17	24.11	0.92	23.00	26.00	3.84
LE	17	12.82	0.95	12.00	15.00	7.41
GLS	17	28.51	0.62	27.30	29.75	2.18
ZB	17	13.00	0.51	12.30	14.45	3.92
POC	18	7.21	0.23	6.95	7.80	3.31
MB	18	13.16	0.38	12.60	14.30	2.93
LN	17	11.52	0.43	10.75	12.35	3.77
LPM	17	12.52	0.44	11.75	13.25	3.53
LR	17	12.25	0.37	11.50	12.90	3.07
IW	18	8.33	0.31	7.40	8.85	3.73
IL	18	3.23	0.31	2.50	3.85	9.80
LMT	18	4.75	0.16	4.50	5.05	3.40
TLT	18	13.43	0.39	12.75	14.10	2.93
BM	18	5.71	0.18	5.40	6.20	3.24
PPW	18	4.87	0.70	5.15	5.35	4.43
DBC	18	9.47	0.22	9.10	9.95	2.36

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 38			
TL	17	215.41	8.73	204.00	240.00	4.05
LT	17	109.35	5.21	103.00	125.00	4.77
LHF	18	26.05	1.05	25.00	29.00	4.05
LE	18	14.00	0.97	13.00	17.00	6.93
GLS	18	29.90	0.91	28.95	32.70	3.06
ZB	18	13.73	0.56	13.15	15.60	4.14
POC	18	7.33	0.45	6.30	8.45	6.14
MB	18	13.50	0.36	13.05	14.60	2.71
LN	18	12.12	0.39	11.40	12.85	3.24
LPM	18	13.12	0.52	12.20	14.30	3.99
LR	18	12.69	0.56	12.10	14.40	4.43
IW	18	8.80	0.31	8.30	9.30	3.52
IL	18	3.84	0.45	3.05	4.95	11.85
LMT	18	5.07	0.19	4.80	5.75	3.88
TLT	18	13.98	0.48	13.35	15.65	3.48
BM	18	5.92	0.30	5.60	6.85	5.10
PPW	18	5.10	0.17	4.80	5.50	3.42
DBC	18	9.66	0.20	9.50	10.40	2.16

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 39			
TL	11	244.81	9.28	230.00	262.00	3.79
LT	11	127.54	5.69	120.00	138.00	4.46
LHF	12	29.33	1.23	27.00	31.00	4.19
LE	12	15.41	0.51	15.00	16.00	3.34
GLS	12	31.69	0.86	30.30	32.60	2.71
ZB	12	14.46	0.43	13.75	15.10	3.02
POC	12	7.79	0.34	7.15	8.50	4.47
MB	12	13.78	0.29	13.20	14.25	2.14
LN	12	12.86	0.56	11.85	13.50	4.37
LPM	12	13.88	0.44	13.05	14.65	3.21
LR	12	13.90	0.49	13.20	14.55	3.54
IW	12	8.87	0.26	8.45	9.40	3.00
IL	12	4.60	0.18	4.30	5.05	4.04
LMT	12	5.14	0.13	4.90	5.35	2.65
TLT	12	14.80	0.37	14.20	15.30	2.50
BM	12	5.90	0.14	5.70	6.15	2.48
PPW	12	5.21	0.21	4.90	5.50	4.17
DBC	12	9.99	0.23	9.50	10.35	2.39

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 40			
TL	1	192.00				
LT	1	93.00				
LHF	1	24.00				
LE	1	16.00				
GLS	1	28.20				
ZB	1	12.90				
POC	1	7.05				
MB	1	13.60				
LN	1	11.35				
LPM	1	12.20				
LR	1	11.80				
IW	1	8.45				
IL	1	3.50				
LMT	1	4.70				
TLT	1	13.25				
BM	1	5.65				
PPW	1	4.80				
DBC	1	9.70				

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 41			
TL	200	226.48	16.64	119.00	262.00	7.35
LT	200	115.38	9.47	92.00	166.00	8.21
LHF	208	27.81	1.98	17.00	32.00	7.14
LE	206	13.75	1.62	9.00	19.00	11.81
GLS	194	30.79	1.19	26.30	34.60	3.86
ZB	185	14.35	0.65	12.45	16.85	4.53
POC	212	7.55	0.43	3.40	9.00	5.76
MB	211	13.96	0.38	12.80	15.50	2.73
LN	193	12.44	0.70	10.30	14.50	5.63
LPM	193	13.24	0.72	11.15	15.75	5.49
LR	193	13.41	0.70	10.70	15.75	5.25
IW	210	8.73	0.53	6.65	10.05	6.08
IL	212	4.64	0.39	3.35	5.65	8.49
LMT	208	5.00	0.20	4.27	6.10	4.03
TLT	208	14.30	0.59	12.50	16.90	4.15
BM	210	5.89	0.28	5.00	7.40	4.83
PPW	212	5.17	0.21	4.65	6.10	4.23
DBC	210	9.82	0.27	9.20	10.95	2.84

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 42			
TL	5	225.40	12.46	210.00	241.00	5.52
LT	5	116.60	9.60	105.00	128.00	8.24
LHF	5	26.60	1.81	25.00	29.00	6.82
LE	5	14.60	1.34	13.00	16.00	9.18
GLS	5	30.11	1.05	28.85	31.45	3.49
ZB	5	13.72	0.35	13.25	14.10	2.55
POC	5	7.40	0.17	7.20	7.60	2.38
MB	5	13.67	0.11	13.55	13.85	0.84
LN	5	12.53	0.64	11.95	13.50	5.14
LPM	5	13.37	0.56	12.70	14.15	4.23
LR	5	13.02	0.68	12.20	14.00	5.25
IW	5	8.62	0.63	7.80	9.20	7.31
IL	5	4.16	0.46	3.50	4.65	11.12
LMT	5	4.85	0.19	4.65	5.10	3.99
TLT	5	14.03	0.52	13.35	14.60	3.76
BM	5	5.85	0.29	5.50	6.30	5.05
PPW	5	5.05	0.28	4.85	5.55	5.64
DBC	5	9.55	0.16	9.40	9.80	1.77

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 43			
TL	28	204.64	18.37	172.00	243.00	8.98
LT	28	103.10	12.20	80.00	129.00	11.83
LHF	28	24.60	1.98	20.00	30.00	8.07
LE	24	13.87	1.51	12.00	17.00	10.90
GLS	33	28.61	1.40	26.20	32.55	4.91
ZB	34	13.14	0.80	11.95	15.20	6.09
POC	35	7.26	0.34	6.40	8.10	4.78
MB	35	13.51	0.40	12.40	14.50	2.97
LN	33	11.45	0.66	10.30	12.90	5.85
LPM	33	12.18	0.68	11.25	14.10	5.62
LR	33	12.05	0.74	10.60	13.55	6.20
IW	35	8.56	0.34	7.60	9.25	4.04
IL	35	3.84	0.56	3.05	5.00	14.74
LMT	31	4.64	0.19	4.10	5.15	4.29
TLT	32	13.44	0.66	12.10	15.00	4.97
BM	29	5.56	0.22	5.10	5.90	4.00
PPW	35	4.88	0.19	4.50	5.30	3.98
DBC	35	9.44	0.28	8.85	10.15	2.98

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 44			
TL	4	203.50	11.12	196.00	220.00	5.46
LT	4	103.25	9.21	93.00	112.00	8.92
LHF	4	25.25	2.62	23.00	29.00	10.41
LE	4	13.50	1.73	12.00	15.00	12.83
GLS	4	28.91	0.81	27.80	29.60	2.83
ZB	3	13.08	0.66	12.65	13.85	5.08
POC	4	7.18	0.44	6.60	7.60	6.18
MB	4	13.57	0.24	13.30	13.90	1.81
LN	4	11.83	0.48	11.35	12.50	4.11
LPM	4	12.38	0.27	12.00	12.65	2.24
LR	4	12.42	0.70	11.70	13.05	5.63
IW	4	8.70	0.55	8.20	9.30	6.41
IL	4	4.05	0.66	3.35	4.95	16.50
LMT	4	4.63	0.18	4.40	4.85	4.07
TLT	4	13.36	0.55	12.60	13.80	4.16
BM	4	5.51	0.19	5.25	5.70	3.50
PPW	4	4.78	0.21	4.55	5.05	4.46
DBC	4	9.35	0.28	8.95	9.60	3.05

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 45			
TL	16	210.75	7.86	194.00	225.00	3.73
LT	16	104.12	4.85	94.00	114.00	4.66
LHF	18	24.88	0.67	24.00	26.00	2.71
LE	18	13.38	0.69	12.00	14.00	5.21
GLS	19	29.20	0.86	27.85	31.00	2.96
ZB	20	13.27	0.58	12.10	14.35	4.42
POC	20	7.40	0.31	6.80	8.10	4.29
MB	20	13.71	0.37	13.15	14.50	2.75
LN	19	11.81	0.56	10.80	13.00	4.82
LPM	19	12.68	0.60	11.85	14.25	4.76
LR	19	12.36	0.45	11.55	13.20	3.70
IW	20	8.66	0.42	8.10	9.70	4.88
IL	20	3.62	0.25	3.25	4.15	7.09
LMT	19	4.74	0.13	4.55	5.00	2.88
TLT	20	13.52	0.38	12.75	14.30	2.88
BM	19	5.66	0.24	5.20	6.25	4.25
PPW	20	4.83	0.17	4.45	5.20	3.70
DBC	20	9.63	0.15	9.30	9.90	1.64

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 46			
TL	18	214.94	10.32	199.00	233.00	4.80
LT	18	109.66	6.38	101.00	125.00	5.82
LHF	21	25.23	0.62	24.00	26.00	2.47
LE	21	14.00	0.77	13.00	16.00	5.53
GLS	21	29.53	0.67	28.15	30.90	2.29
ZB	20	13.37	0.54	11.80	14.40	4.10
POC	21	7.41	0.27	6.90	8.15	3.75
MB	21	13.76	0.30	13.15	14.25	2.25
LN	21	12.02	0.46	11.15	13.00	3.87
LPM	21	12.83	0.52	11.70	14.00	4.06
LR	21	12.49	0.42	11.70	13.30	3.41
IW	21	8.71	0.29	8.20	9.50	3.38
IL	21	3.73	0.32	3.20	4.80	8.69
LMT	20	4.77	0.15	4.50	5.10	3.26
TLT	21	13.78	0.37	13.00	14.50	2.74
BM	21	5.65	0.16	5.35	6.00	2.86
PPW	21	4.87	0.14	4.55	5.10	3.00
DBC	21	9.55	0.19	9.25	10.00	2.01

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 47			
TL	17	211.70	9.49	194.00	229.00	4.48
LT	17	110.29	5.72	104.00	125.00	5.18
LHF	20	24.90	0.71	23.00	26.00	2.88
LE	20	13.55	0.60	13.00	15.00	4.46
GLS	20	28.84	0.58	27.95	30.45	2.03
ZB	19	13.39	0.34	12.55	14.05	2.59
POC	20	7.40	0.21	7.00	7.85	2.87
MB	20	13.50	0.44	11.95	14.05	3.27
LN	20	11.75	0.46	11.10	12.60	3.94
LPM	20	12.53	0.46	11.70	13.70	3.73
LR	20	12.18	0.41	11.40	13.00	3.43
IW	20	8.86	0.28	8.35	9.50	3.22
IL	20	3.68	0.31	3.00	4.20	8.42
LMT	20	4.78	0.17	4.50	5.20	3.58
TLT	20	13.50	0.36	13.00	14.35	2.69
BM	20	5.63	0.13	5.40	5.90	2.36
PPW	20	4.89	0.11	4.65	5.10	2.41
DBC	20	9.55	0.29	9.10	10.60	3.13

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 48			
TL	6	225.00	10.05	211.00	241.00	4.47
LT	6	112.66	6.68	105.00	122.00	5.93
LHF	6	28.33	2.16	25.00	31.00	7.62
LE	6	13.00	0.89	12.00	14.00	6.88
GLS	6	30.70	1.08	29.75	32.65	3.52
ZB	6	14.14	0.68	13.45	15.35	4.84
POC	6	7.42	0.47	6.85	8.05	6.42
MB	6	13.96	0.36	13.45	14.50	2.57
LN	6	12.15	0.60	11.40	13.00	5.01
LPM	6	13.27	0.74	12.00	14.25	5.61
LR	6	13.05	0.57	12.70	14.20	4.38
IW	6	8.69	0.63	8.00	9.75	7.27
IL	6	4.65	0.36	4.20	5.20	7.87
LMT	6	5.10	0.05	5.00	5.15	1.14
TLT	6	14.21	0.46	13.80	15.05	3.26
BM	6	5.90	0.18	5.70	6.15	3.12
PPW	6	5.38	0.25	5.05	5.70	4.72
DBC	6	9.86	0.26	9.55	10.25	2.71

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 49			
TL	7	188.28	37.14	125.00	226.00	19.72
LT	7	97.71	13.71	82.00	118.00	14.04
LHF	7	23.71	1.11	22.00	25.00	4.69
LE	7	12.85	1.34	11.00	14.00	10.46
GLS	6	28.47	0.97	27.10	29.85	3.42
ZB	7	12.99	0.45	12.30	13.50	3.48
POC	7	7.22	0.30	6.90	7.70	4.20
MB	7	13.31	0.29	12.90	13.80	2.24
LN	6	11.63	0.60	10.95	12.35	5.16
LPM	6	12.44	0.49	11.70	13.10	4.00
LR	6	12.14	0.61	11.45	13.10	5.06
IW	7	8.65	0.43	8.15	9.40	5.04
IL	7	3.55	0.24	3.30	3.90	6.85
LMT	7	4.65	0.12	4.45	4.80	2.63
TLT	7	13.19	0.42	12.60	13.65	3.19
BM	7	5.52	0.11	5.40	5.70	2.14
PPW	7	4.79	0.09	4.70	4.95	2.03
DBC	7	9.41	0.16	9.15	9.65	1.78

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 50			
TL	7	233.28	12.61	214.00	249.00	5.40
LT	7	117.85	6.14	106.00	124.00	5.21
LHF	7	29.57	0.97	28.00	31.00	3.30
LE	7	15.57	0.97	14.00	17.00	6.26
GLS	4	31.75	0.96	30.85	33.10	3.02
ZB	5	14.82	0.47	14.30	15.40	3.18
POC	6	7.57	0.19	7.35	7.85	2.59
MB	6	14.65	0.31	14.10	14.95	2.17
LN	6	13.24	0.61	12.65	14.10	4.67
LPM	6	13.86	0.34	13.35	14.35	2.50
LR	6	13.92	0.45	13.15	14.45	3.28
IW	7	8.80	0.60	8.00	9.40	6.84
IL	6	4.23	0.29	3.90	4.70	7.07
LMT	7	4.76	0.16	4.50	5.00	3.41
TLT	7	14.60	0.35	14.00	15.20	2.44
BM	6	5.80	0.19	5.55	6.10	3.40
PPW	6	5.21	0.27	4.85	5.65	5.23
DBC	6	9.95	0.15	9.70	10.10	1.55

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 51			
TL	1	232.00				
LT	1	117.00				
LHF	2	27.00	2.82	25.00	29.00	10.47
LE	2	15.00	1.41	14.00	16.00	9.42
GLS	2	31.27	0.88	30.65	31.90	2.82
ZB	2	14.05	0.49	13.70	14.40	3.52
POC	2	7.20	0.56	6.80	7.60	7.85
MB	2	14.25	0.49	13.90	14.60	3.47
LN	2	13.02	0.10	12.95	13.10	0.81
LPM	2	13.80	0.28	13.60	14.00	2.05
LR	2	13.42	0.38	13.15	13.70	2.89
IW	2	8.90	0.56	8.50	9.30	6.35
IL	2	4.72	0.95	4.05	5.40	20.20
LMT	2	4.80	0.28	4.60	5.00	5.89
TLT	2	14.27	0.38	14.00	14.55	2.72
BM	2	5.75	0.35	5.50	6.00	6.14
PPW	2	5.07	0.03	5.05	5.10	0.69
DBC	2	9.82	0.10	9.75	9.90	1.08

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 52			
TL	5	211.20	15.05	190.00	232.00	7.12
LT	5	102.60	9.12	94.00	115.00	8.89
LHF	5	24.60	0.54	24.00	25.00	2.22
LE	5	13.20	0.44	13.00	14.00	3.38
GLS	5	29.95	1.60	27.50	31.35	5.35
ZB	5	13.65	0.52	12.90	14.35	3.86
POC	5	7.24	0.39	6.65	7.65	5.49
MB	5	13.63	0.17	13.50	13.90	1.26
LN	5	12.40	0.70	11.30	13.00	5.70
LPM	5	13.31	0.66	12.30	14.05	5.00
LR	5	12.82	0.63	11.80	13.35	4.96
IW	5	8.45	0.52	7.90	9.25	6.16
IL	5	3.52	0.12	3.40	3.70	3.56
LMT	5	5.03	0.14	4.90	5.25	2.86
TLT	5	14.15	0.68	13.10	14.95	4.80
BM	5	5.76	0.24	5.50	6.10	4.31
PPW	5	5.03	0.14	4.85	5.20	2.86
DBC	5	9.72	0.40	9.05	10.10	4.15

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 53			
TL	14	206.21	13.70	189.00	239.00	6.64
LT	14	100.71	9.31	91.00	120.00	9.25
LHF	15	24.53	0.51	24.00	25.00	2.10
LE	15	13.53	0.51	13.00	14.00	3.81
GLS	15	28.98	0.74	27.95	30.80	2.56
ZB	14	13.39	0.41	12.80	14.20	3.08
POC	14	7.05	0.36	6.40	7.65	5.17
MB	15	13.27	0.26	12.75	13.60	2.03
LN	15	11.87	0.44	11.20	12.85	3.77
LPM	15	12.54	0.44	11.90	13.40	3.54
LR	15	12.35	0.46	11.80	13.35	3.79
IW	15	8.56	0.43	7.60	9.25	5.04
IL	15	3.62	0.26	3.15	4.15	7.44
LMT	15	4.88	0.19	4.50	5.10	4.00
TLT	15	13.49	0.31	13.00	14.25	2.36
BM	15	5.58	0.22	5.10	5.90	4.00
PPW	15	4.94	0.19	4.65	5.30	3.91
DBC	15	9.57	0.28	9.20	10.05	2.96

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 54			
TL	11	209.36	15.02	186.00	240.00	7.17
LT	11	105.09	9.76	92.00	124.00	9.28
LHF	11	26.18	1.16	24.00	28.00	4.46
LE						
GLS	11	29.76	1.01	27.95	31.40	3.41
ZB	11	13.85	0.46	13.00	14.60	3.36
POC	11	7.15	0.21	6.75	7.45	2.95
MB	11	13.62	0.25	13.40	14.30	1.88
LN	11	12.32	0.66	11.25	13.10	5.35
LPM	11	13.27	0.56	12.30	14.10	4.28
LR	11	12.74	0.61	11.75	13.70	4.82
IW	11	8.31	0.27	7.90	8.80	3.29
IL	11	3.66	0.31	3.20	4.15	8.65
LMT	10	5.10	0.18	4.90	5.40	3.59
TLT	10	14.22	0.55	13.40	15.30	3.89
BM	11	5.99	0.19	5.70	6.30	3.20
PPW	11	5.11	0.19	4.85	5.50	3.89
DBC	10	9.51	0.21	9.10	9.90	2.24

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 55			
TL	20	207.55	10.35	186.00	225.00	4.98
LT	20	105.70	7.38	93.00	121.00	6.98
LHF	22	24.86	1.16	23.00	27.00	4.69
LE	22	12.40	1.25	11.00	17.00	10.15
GLS	23	28.66	1.13	25.85	30.70	3.94
ZB	23	13.05	0.55	11.90	14.00	4.26
POC	27	6.87	0.29	6.20	7.65	4.29
MB	25	13.31	0.43	12.55	14.20	3.27
LN	25	11.71	0.61	10.20	13.40	5.27
LPM	25	12.34	0.71	10.90	13.85	5.76
LR	25	12.24	0.62	10.75	13.45	5.07
IW	25	8.29	0.49	7.50	9.60	5.98
IL	25	3.34	0.35	2.55	3.90	10.56
LMT	27	4.65	0.14	4.40	5.00	3.03
TLT	26	13.34	0.52	12.20	14.70	3.96
BM	27	5.50	0.29	4.95	5.95	5.33
PPW	26	4.86	0.25	4.50	5.55	5.18
DBC	24	9.27	0.30	8.65	9.95	3.33

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 56			
TL	5	212.00	7.34	201.00	219.00	3.46
LT	5	106.80	6.72	100.00	115.00	6.29
LHF	5	25.00	0.70	24.00	26.00	2.82
LE	5	13.60	0.54	13.00	14.00	4.02
GLS	5	29.58	0.51	29.00	30.05	1.73
ZB	5	13.50	0.46	13.20	14.30	3.42
POC	5	7.02	0.29	6.70	7.45	4.17
MB	5	13.68	0.37	13.20	14.20	2.76
LN	5	11.80	0.63	11.00	12.60	5.36
LPM	5	12.83	0.39	12.30	13.35	3.11
LR	5	12.72	0.50	12.15	13.25	3.95
IW	5	8.74	0.36	8.40	9.35	4.15
IL	5	3.93	0.74	3.20	5.15	18.99
LMT	5	4.86	0.23	4.60	5.15	4.79
TLT	5	13.66	0.25	13.30	14.00	1.83
BM	5	5.75	0.14	5.60	5.90	2.46
PPW	5	4.87	0.17	4.70	5.10	3.67
DBC	5	9.53	0.07	9.45	9.65	0.79

Appendix 2. Continued.

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 57			
TL	24	239.91	14.24	202.00	263.00	5.93
LT	24	126.08	8.67	103.00	144.00	6.88
LHF	29	28.65	1.14	26.00	31.00	3.98
LE	29	14.93	0.59	13.00	16.00	3.97
GLS	29	31.70	1.46	28.05	35.30	4.63
ZB	29	14.59	0.70	12.70	15.75	4.85
POC	29	7.38	0.29	6.80	7.90	3.98
MB	29	14.24	0.44	13.15	15.15	3.10
LN	29	12.63	0.78	11.45	14.60	6.22
LPM	29	13.25	0.75	12.15	15.00	5.67
LR	29	13.91	0.80	12.05	16.10	5.81
IW	29	7.98	0.48	7.05	8.95	6.13
IL	29	4.32	0.33	3.25	5.10	7.71
LMT	28	5.08	0.21	4.40	5.45	4.21
TLT	28	14.90	0.66	13.15	16.65	4.43
BM	28	5.69	0.19	5.15	6.10	3.50
PPW	29	5.23	0.19	4.75	5.50	3.80
DBC	29	9.99	0.31	9.05	10.45	3.16

CHAR	N	MEAN	SD	MIN	MAX	C.V.
			GROUPED LOCALITY 58			
TL	44	227.25	18.38	188.00	259.00	8.08
LT	44	118.56	12.38	92.00	142.00	10.44
LHF	49	27.46	2.39	23.00	31.00	8.73
LE	49	14.38	1.18	12.00	16.00	8.25
GLS	49	30.42	1.61	27.15	33.00	5.29
ZB	46	14.09	0.83	12.35	15.60	5.89
POC	49	7.43	0.45	6.60	8.80	6.17
MB	49	13.82	0.45	13.10	14.75	3.28
LN	49	12.47	0.90	10.60	14.20	7.29
LPM	49	13.20	0.91	11.30	15.00	6.89
LR	49	13.21	0.95	11.25	14.70	7.22
IW	49	8.62	0.42	7.80	9.55	4.94
IL	49	4.28	0.52	3.30	5.30	12.22
LMT	49	4.87	0.22	4.15	5.35	4.66
TLT	49	14.24	0.73	12.55	15.50	5.15
PPW	49	5.07	0.24	4.60	5.65	4.86
BM	49	5.87	0.29	5.40	6.80	4.99
DBC	49	9.68	0.30	9.10	10.30	3.09